POWER

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ELY C. HUTCHINSON, *Editor*

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Don't Worry

"I am an old man and have had many troubles —most of which never happened."

IT IS easy to say "Don't worry," but it is not so easy to avoid it. In fact, it is impossible sometimes not to give up to it; and for some people worry seems to be the normal condition.

Their consciousness, instead of being glad with appreciation of the blessings which are really theirs, is clouded with gloomy forebodings of troubles that may come. Instead of a happy realization of present good they live in a depressing atmosphere of apprehended evil.

And "As a man thinketh so is he." He suffers mentally these troubles as keenly as though they actually occurred. His capacity for cheery friendliness and intercourse is blunted. He shuts out the sunshine, chills sensitive affection and discourages congeniality by a fog of melancholy forebodings of his own creation.

We all know him, the man who cannot enjoy a trip for fear of accident, who cannot read a medicine advertisement or learn the details of another's illness without imagining himself the subject of the same symptoms, whose mind at the theatre is on the fire exit instead of on the stage, who not only carries his business around with him but loads it with the conception of every conceivable disaster.

It may be morbidness, it may be nerves, it may be liver. Whatever it is it reduces one's enjoyment of life, one's ability to sleep well o'nights, one's capacity to make the most of one's abilities and opportunities.

And it is all so useless. Trouble is invited rather than averted by dwelling upon it. Don't add to those with which you will really have to deal by conjuring up a lot of others that will probably never happen.

The best way to snap out of it is to resolve the worry into justified admonition and unwarranted apprehension. Respond to the admonition with every possible precaution. Don't try to be easy in the thought that evil may not happen, but do all you can to reduce its probability.

And forget the rest in interested work that, if it does not keep trouble itself away, will drown the thought of it and may produce compensating advantages.

F. R. Low

EDITORIALS

The Platform for American Business

IT IS HOPED that the readers of *Power* have had the time and inclination to read and ponder upon the Platform for American Business that was included as a supplement to last week's number. Some may have felt that because they were only working for their concern and not running it, the responsibility was the "boss's," not theirs. Others may have scanned it and, failing to find any direct application to their own case, have put it aside as having nothing to do with them.

Only those who think they have no interest in so upbuilding the entire economic system that it may, in the future, be proof against the ills which have recently caused so much suffering and deprivation, can be excused for their lack of understanding.

The platform is necessarily general and abstract in many of its pronouncements, since it is not written for any one business or industry, but for all. It is left to the far-seeing wisdom of the individual or the business executive to interpret what he reads, into the terms suited to himself. It is a platform of principles and, as such, affords the inspiration and force to move all men in the common direction. This is where the greatest hope and benefit lies for the years to come.

Read the platform, discuss it with the man next door, start thinking about the planks. Write *Power* for help if things are not clear. But above all do your part in helping to live it and spread its gospel.

You may not feel the benefit so much, but your children will.

Dust Collector Efficiency

THE EFFICIENCY of dust-collecting equipment generally is expressed as the percentage by weight of dust removed based on that carried by the entering gas. Sometimes, however, it is based on screening analysis instead of on the total weight of entering dust, and the resulting efficiency is misleading. Even though the total weight of dust is used in guaranteeing the performance of a collector, the efficiency gives little indication of the performance as far as the dust loading of the exit gas is concerned. It is this that the engineer is primarily interested in, as the collector is installed in power plants to reduce the dust loading to such a point that it no longer constitutes a nuisance.

If a collector guaranteed to remove 80 per cent of the dust were installed, and the dust loading of the entering flue gas was 1.5 grains per cubic foot, the gas leaving the collector would contain only 0.3 grain per cubic foot. If the dust loading of the entering gas were to increase to 5 grains per cubic foot, the exit gas loading would be 1 grain per cubic foot, which might be objectionable.

It might appear that guarantees which state the dust loading of the leaving gas would be more satisfactory to the power engineer. It is, however, first necessary to arrive at some conclusion or standard concerning the maximum dust loading permissible before a nuisance is created, and to develop an instrument for indicating to the operating engineer the amount of dust in the stack gas.

Steam Turbine Speeds For High Pressures

STEAM TURBINES for pressures in excess of one thousand pounds are made in two cylinders. The volumes of steam to be handled in the high-pressure turbine are small in comparison with those in the low-pressure unit. Hence, the nozzles and blades are also relatively small. If part admission is employed, the blade losses in the section of the disks not receiving steam become excessive at these high pressures. Designers therefore aim to secure full peripheral admission on all stages.

The high-pressure turbine can be designed with few stages and a large heat drop per stage, or with many stages and a small heat drop in each. To secure high efficiency the ratio of blade speed to steam speed should approach the theoretical. But disk losses increase as the square of the diameter of the wheel. Hence, the

designer usually strives for high rotative speed and small-diameter wheels for a given blade speed. These also permit of larger nozzles and longer blades, which is desirable. Three thousand six hundred revolutions per minute is common for high-pressure turbines.

Would still higher revolutions per minute and the employment of reduction gears lead to more efficient and cheaper high-pressure turbines? Inasmuch as reduction gears can now be built that are comparatively free from noise and have a reasonably long life, their use with high-speed turbines should not be objectionable: With reduction gears, turbine speeds of seven thousand five hundred or even ten thousand revolutions per minute might be possible. Such speeds would permit casings and rotors to be smaller than at present, and hence less subject to stresses and deformations. Furthermore, the cost of construction would be less, floor space would be less, and efficiency might possibly be higher than in units as now constructed.

These considerations suggest interesting possibilities in new construction of high-speed, high-pressure turbines.

Hotel Statistics And Other Indoor Sports

PUBLICATION of a speech does not imply agreement with its content. The editors thought this clear in presenting, in the Feb. 17 number of *Power*, an abstract of Edward C. Romine's recent paper on "Light, Heat and Power in New York Hotels." To make double sure that no reader should mistake publication for endorsement, an editorial in the same issue pointed to certain logical flaws in the conclusions presented.

The statistics brought together in Mr. Romine's paper are worth looking into, but some of the conclusions are valuable chiefly as examples of unfounded generalizations from loose-jointed data. One may well agree that it was impractical, or impossible, to list such fundamental data as room size and actual energy consumed by various services and departments. It may well be that it was not convenient to consider those factors of public space, special services, and "class" of hotel that so vitally affect the power services. But does this justify conclusions with no decent foundation of fact?

No attempt was made in the editorial to spot all the chinks in Mr. Romine's statistical armor, but others are assuming the task. Various building engineers in New York City and elsewhere have sharpened their pencils and their comments are already flowing in for early publication.

In this criticism of statistical high jumping, let us not forget another matter that comes closer home to the operating man. Isn't it true that a lot of these perpetually debated questions of power costs in buildings would be settled in a hurry if more plants kept detailed records of steam produced, consumption by departments, and other data essential for a real operating analysis? May we look forward to an engineering Utopia in which owners will pay for instruments, operators will use them intelligently, and accountants will not draw conclusions based on inadequate data?

Keep the Head Gates Open

ENGINEERS worthy of the name take great pride in their achievements. The great designers and constructors spend their effort, always, to achieve the ideal development resulting from careful study of the controlling factors in each case.

In hydro-electric power projects, as in others, all the elements are carefully considered in their relation to cost, permanence, upkeep and efficiency. Always efficiency!

For several years it has been recognized that little more margin remains for improvement of the hydraulic prime movers and that further efficiency of hydro projects must be found in the physical improvement and operation of the development as a whole.

But no matter how carefully or perfectly the project may have been planned and built, operation will still have the whip hand in influencing the balance sheet. The plant is built but once and operation goes on forever.

Just what this may mean is well illustrated by reciting two direct cases where hydro plants were allowed to operate for long periods with their head gates only partly opened. The wire-drawing effect resulted in losses of three to five per cent of the total heads available.

It can not be claimed that these were just temporary conditions, for the contrary evidence was clear. In one case an eight-foot lift was used where the engineers had planned nineteen feet—all because a few nuts interfered and the initiative was lacking to correct the trouble —a job of about two hours.

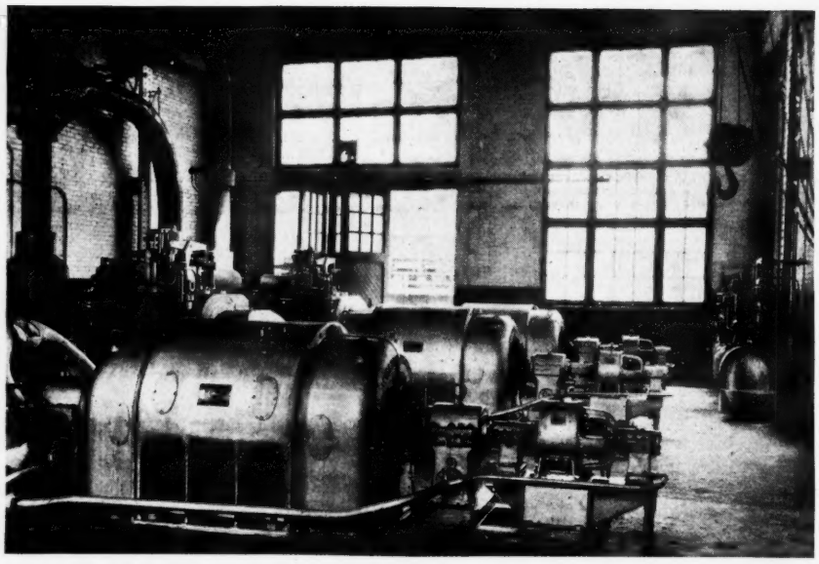
There is no more effective way than this to waste dollars. Meanwhile, those executives and operators who are interested in utilizing to the full the skill and forethought of their designing engineers will do well to watch the head gates.

▼

POWER Stands for . .

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**
8. **Prevention of Smoke, Within Reason**

▼



Two of the turbines are bled at 110 lb. and exhaust at 30 lb.; the other unit operates condensing

ACCUMULATOR

Permits Constant Firing of Pulp-Mill Boilers

At the Restigouche pulp mill of the Fraser Companies, Ltd., both power and process heat are supplied from a 350-lb., 3,000-kw. steam plant. A steam accumulator is installed and the plant is so designed that even though the load varies widely the boilers are operated at practically a constant steaming rate

NORTHERN New Brunswick is rapidly becoming an extensive center of the pulp and paper industry in Canada. Of the several mills in the district that of the Restigouche Company, Ltd., a subsidiary of Fraser Companies, Ltd., is an example of the most modern design. This plant is not only the second largest pulp mill in the Maritime Provinces, the largest being at Edmundston and operated by the same company, but it produces the highest grade of sulphite fiber pulp for use in the manufacture of best quality book paper and rayon. The plant is designed to produce 150 tons of dried sulphite pulp a day.

In the manufacturing processes large quantities of medium- and low-pressure steam are required for cooking and drying. These demands are such that about 75 per cent of the total power required can be generated as a byproduct of the process steam. This allows producing the mill's power at a low expenditure of heat units.

When working out the design of the steam and power plant it was assumed that although the steam and power demands would fluctuate between wide limits for each 24 hr. of operation, a given quantity of steam and of power would be required. The idea was to produce a combination of steam and power equipment that would take care of the fluctuations with practically a constant load on the boilers. This arrangement not only simplifies the plant's operation, and allows supplying steam with a minimum of boiler capacity, but it also permits operating at best efficiency. The equipment can be adjusted to produce the best results for a given set of load conditions and the operators can maintain it with a minimum of effort.

A boiler pressure of 350 lb. was selected. The process steam is supplied by two turbines, operating at 30 lb. back pressure and bleeding at 110 lb. To supply the power required above that produced by the back-pressure turbines a third unit is installed to operate condensing. Fluctuations in the demands for process steam are provided for by an accumulator. The diagram, Fig. 3,

shows the general arrangement of the equipment and piping. The boilers supply 350-lb. steam to a common header. Turbines 2 and 3 are bled at 110 lb. and operate against 30 lb. back pressure. The former is used in the digester for cooking and the latter for bleaching and drying the pulp and for heating the buildings. Turbine 1 operates condensing. All three machines are connected in parallel on the electrical end.

Between the 350- and 110-lb. lines is connected an overflow and reduced-pressure valve V_1. A similar type of valve V_2 is connected between the 110-lb. line and the inlet to the accumulator. Between the outlet of the accumulator and the 50-lb. line there is a reducing valve V_3, and another reducing valve V_4 is connected between the 50- and 30-lb. lines.

Valves V_1 and V_2 function to maintain a constant pressure in the 350-lb. and 110-lb. lines. If the pressure in the 110-lb. line falls below this value, steam is admitted through V_1 as a reducing valve. On the other hand, if the pressure in the 110-lb. line rises above this value, valve V_2 functions and admits steam to the accumulator. If for any reason the pressure in the 350-lb. line rises above this value, valve V_1 functions and admits steam to the 110-lb. line, even though the pressure in that line may be above normal. Steam overflowing from the 350-lb. into the 110-lb. line will generally raise the pressure in this line, and any excess steam will cause valve V_2 to overflow and admit steam to the accumulator.

With all the digesters and dryers in operation, the demand for process steam and power would be at a maximum, with a minimum of steam going to the accumulator. When a digester is taken off a large reduction is made in the demand for 110-lb, process steam, and the pressure goes up in that line and causes an increased flow to the accumulator through valve V_2.

When a digester is being put into service the valve between it and the 50-lb. line is opened and it is gradually brought up to this pressure by steam taken from the accumulator. If there is not sufficient steam in the accumulator to supply this demand, when the pressure drops below 50 lb., V_2 acts as a reducing valve and supplies steam from the 110-lb. line through the accumulator into the digester. If there is insufficient steam from the turbines to meet this demand, the pressure will drop slightly and valve V_1 will operate to supply the deficiency from the 350-lb. line.

If a large block of electric load is dropped there will be a reduction in the demand in steam from the boilers and the pressure will tend to rise in the high line and cause valve V_1 to overflow and pass the excess steam into the intermediate line. If this steam is not needed in this line valve V_2 overflows and passes it to the accumulator.

From the foregoing it is evident that the accumulator is made to act to absorb any excess of steam in the 110- and 350-lb. lines and to supply any deficiency in the 30- and 50-lb. lines.

There are four boilers, two coal-fired and two burning wood refuse. One coal-fired and one refuse-burning boiler have sufficient capacity to take care of the load at all times. The coal-fired boilers are equipped with economizer, air preheaters, water walls and superheaters. Each of the boilers has 8,250 sq.ft.; the economizer 4,200 sq.ft.; the air preheater 10,000 sq.ft.; the water walls 5,300; and the superheaters 1,595 sq.ft. of heating surface, making a total of 29,345 sq.ft. of heat-absorbing

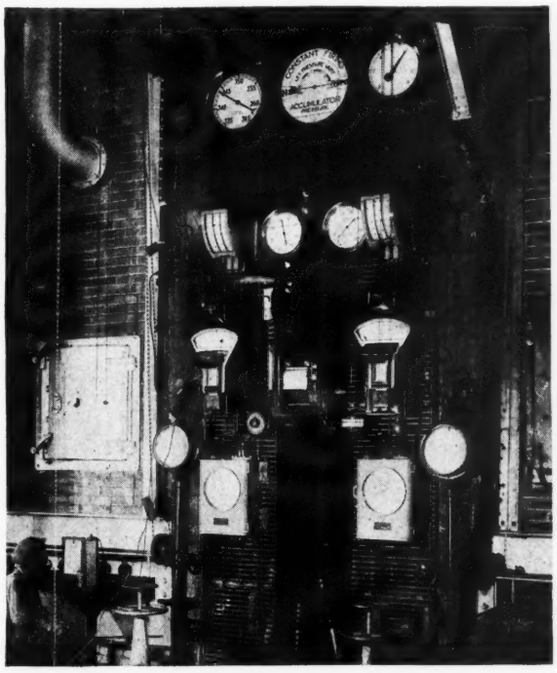


Fig. 1 (Above)—Gage board between the two coal-fired boilers. On this board are all the meters and gages necessary to operate the boilers under best conditions. A flue-gas analyzer is connected permanently to the boilers and daily checks are made on the flue gas

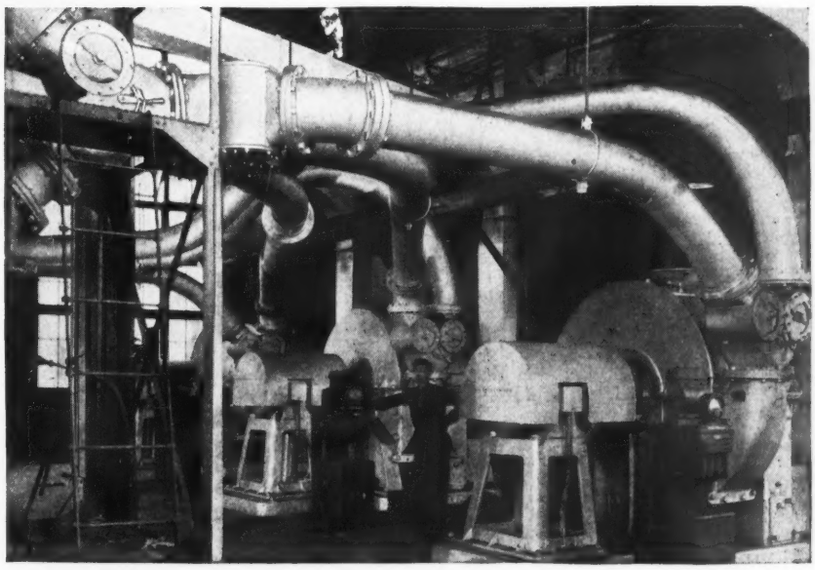


Fig. 2 (Right)—The three pulverizers are connected to the two burners on each boiler so that one, two or three of the pulverizers may be connected to either boiler

surface. They are each guaranteed to produce 140,000 lb. of steam per hour at 350 lb. gage pressure and 200 deg. superheat and to have an efficiency of 88½ per cent. The water walls are on all four sides of the furnaces, with the tubes exposed to the direct radiant heat of the furnace. The boilers are entirely incased in steel plate, with a monolithic wall of heat-resisting and heat-insulating material poured between the tubes and the steel-plate casing. The lower part of the boiler and the ashpit are supported on springs to allow for expansion and contraction.

Directly back of the boilers are the economizers, which are separated from the steel casings inclosing the boilers. Feed water enters the economizer at 230 deg. F. and leaves at 350 deg. A vertical tubular-type preheater is installed back of the economizer. The arrangement is such that the hot gases from the boiler pass down over the vertical tube of the economizer and up inside the air preheater tubes. Both the induced- and forced-draft fans are above the air preheaters. After passing through the preheater the gases go through the induced-draft fans and directly to the stack above the boilers. The forced-draft fans take combustion air from over the boilers, force it downward over the outside of the preheater tubes and to ducts that pass around the boilers on a level with the pulverized-coal burners and connect with them to supply secondary air.

Coal is stored in a 500-ton overhead bunker. From there it is delivered to the hoppers of three pulverizers by a weighing larry operated from the boiler room floor. By weighing the coal to each pulverizer a check on their condition is obtained, as well as on the amount of coal burned by the boiler.

There are three pulverizers on the boiler room floor, each with a rating of 7,000 lb. per hour. The pulverizer connections to the burners are so arranged that one, two or three of them may be connected to either of the boilers. On each pulverizer there is a manifold from which a pipe leads to each boiler. In the manifold a gate valve acts to open and close the passage to the pipe line and a butterfly valve deflects the coal into either pipe.

Pulverizer Connections to Burners

A pipe from each pulverizer terminates in a three-connection manifold near the burners, and from there connections lead to each of the two burners on the furnace. This manifold is provided with suitable gates and deflectors to control the amount of coal to each burner. The two burners, instead of being placed in the common horizontal position, are located one above the other.

The secondary-air ducts on each boiler are connected by a primary-air duct. By means of a damper at each

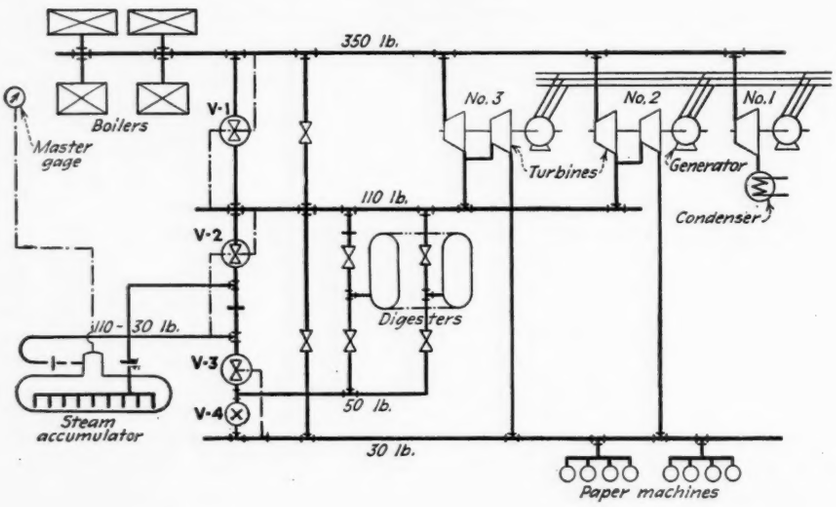
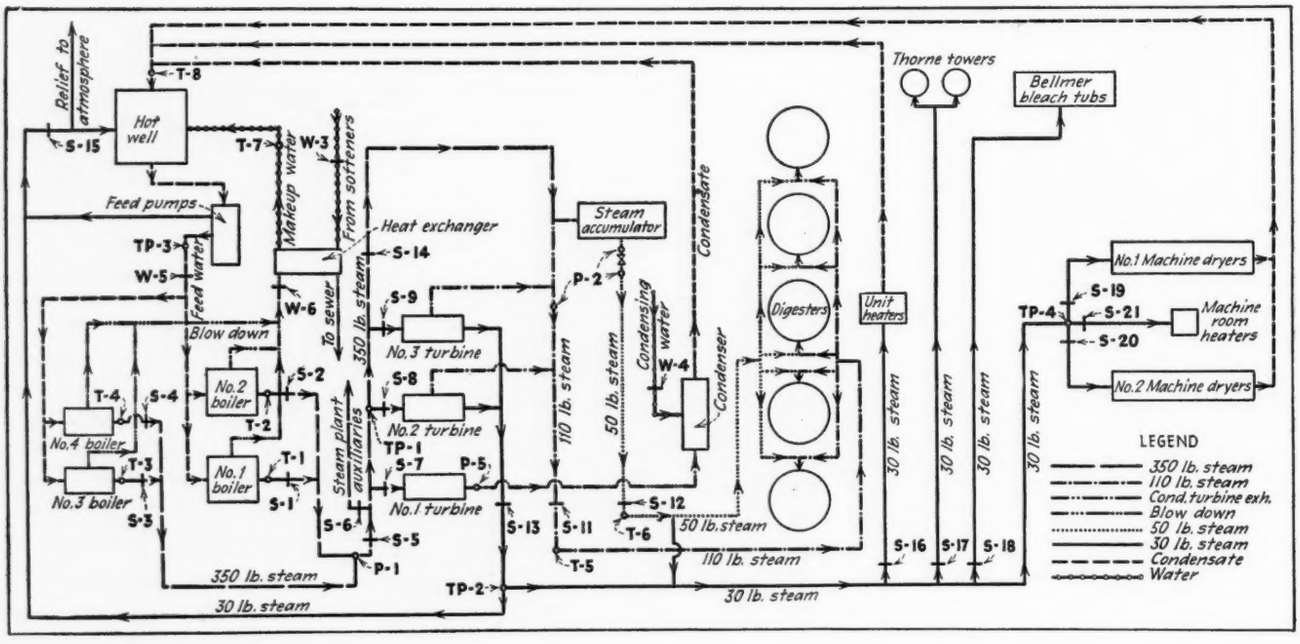


Fig. 3 (Left)—Diagram of steam connections between the boilers, turbines, accumulator and the process

Fig. 4 (Below)—Diagram of steam and water piping, showing where the meters are connected. The symbols on this diagram correspond to those on Fig. 6



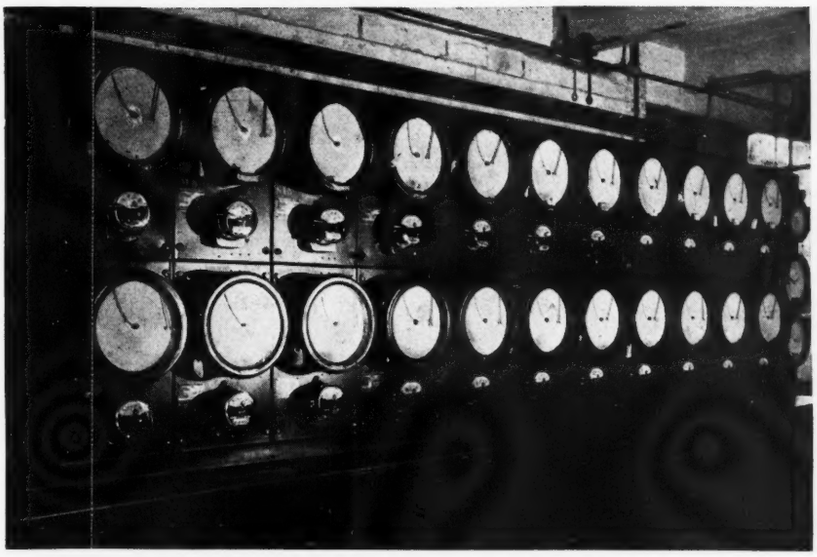


Fig. 5—Main recording and integrating meter board for steam pressures, quantities and temperatures

end the primary-air duct is connected to the secondary-air duct of the boiler in service. From the primary-air duct a connection runs to each pulverizer. Normally the primary air to the pulverizer is preheated air from the secondary-air duct. If the coal happens to be unusually moist, the primary-air duct has a direct connection to the front of the furnace, through which hot gases may be taken into the pulverizers through the primary-air connection.

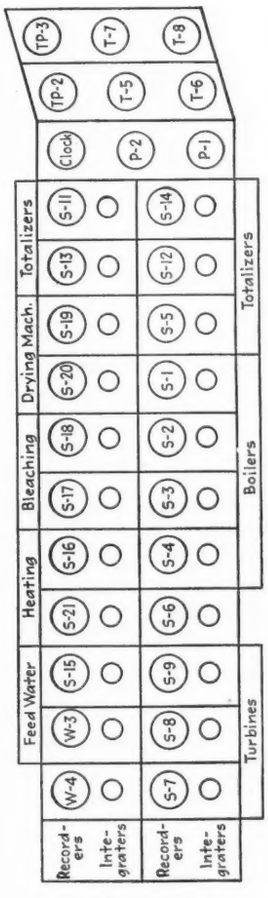
All the control equipment for the boilers is concentrated on the operating floor. The coal larry control and scale are there; also the pulverizers with their motor and control. Control for the forced- and induced-draft fans is conveniently near the boiler fronts. The speed of these motors is regulated by secondary liquid-resistance control, adjustment being made by a hand-wheel on the control of each motor. The wheels for the forced-draft fan and for the induced-draft fan motors are on the same pedestal, one above the other.

The gage board, Fig. 1, is between the two boilers. There is a master steam gage with a pressure range from 335 to 365 lb. There is also a pressure gage for each boiler. A three-point draft gage for each boiler shows the draft in the furnace, in the uptake from the boiler and in the primary-air duct. Another draft gage shows the draft at the entrance to the burner. A CO_2 indicator gives the combustion conditions. The water level in the boilers is shown on a recording gage. A four-point air-flow steam-flow meter records the pressure and the temperature of the steam, in addition to giving a record of air and steam flow. Both an indicating and a recording pyrometer are provided and arranged to take temperatures at four points in each furnace and in the gas passes. A large steam-flow indicator clearly shows the total rate of steam flow from all boilers in operation. Alongside of this indicator is the master pressure gage for the accumulator, with a scale graduated for 20 and 120 lb., the working range of the accumulator.

When operating the boilers, effort is made to establish a set of conditions that, by the aid of the accumulator, will take a constant flow of steam from the boilers. The boiler operator watches the steam-flow indicator and fires to hold a constant steam flow as long as the pointer on the accumulator master gage remains within the limits of 20 and 120 lb. If, for any reason, the indicator on the accumulator approaches the lower limit the rate of steam flow is increased to meet the conditions. On the other hand, if the master gage shows that the accumulator has approached the upper limit the steam flow from the boiler is reduced by changing the firing rate.

There are two refuse-burning boilers, each having 3,000 sq.ft. of heating surface. One of these boilers has sufficient capacity to burn all the available refuse for its operation. The boilers are kept steaming at a fairly constant rate and supply about 12 per cent of the total steam at the same conditions, 350 lb. and 200 deg. superheat, as the coal-fired boiler. These boilers are also equipped with meters, including a recording and integrating steam-flow meter, a three-point draft gage, a CO_2 meter and meters to show the steam pressure and temperature at all times.

Three 1,000-kw. turbine-generators operating at 3,600 r.p.m. are installed. Two of the machines are bled at 110 lb. and exhaust against 30 lb. back pressure. The other operates condensing. Power is generated at 600 volts, 60 cycles, 3 phases, and the generators are con-



Meter No.	Records	Location
P-1	Pressure	350 lb. Main boilers
P-2	"	Accumulator
TP-1*	Tem-Press.	350 lb. Turbine main
T-5	"	110 lb. Bleeder "
T-6	"	50 lb. Inter. "
TP-2	"	30 lb. Low-press. "
S-1	Steam Flow	No. 1 Boiler
S-2	"	No. 2 "
S-3	"	No. 3 "
S-4	"	No. 4 "
S-5	"	Totalizer, 350 lb.
S-6	"	St. pl. aux., 350 lb.
S-7	"	No. 1 Turbine, 350 lb.
S-8	"	No. 2 " "
S-9	"	No. 3 " "
S-14	"	To process "
S-11	"	Digesters, 110 lb.
S-12	"	Process, 50 lb.
S-13	"	" 30 lb.
S-10	"	No. 4 Turbine
S-15	"	F.-w. heater, 30 lb.
S-16	"	Heaters, 30 lb.
S-17	"	Bleaching, 1st stage, 30 lb.
S-18	"	" 2nd " "
S-19	"	No. 1 Machine, 30 lb.
S-20	"	No. 2 " "
S-21	"	Mach. room heaters, 30 lb.
W-1 *	Water Flow	From pump house
W-2 *	"	Acid making
W-3	"	Boilers, makeup
W-4	"	To condenser
T-7	Temperature	To heater
T-8	"	Condensate to heater
TP-3	"	Boiler, feed water

* Not on this board

Fig. 6—Diagram of the meter board (Fig. 5), showing what each meter is used for

Principal Equipment in Power Plant of the Restigouche Co., Ltd.

General

Plant location, Athol, N. B., at the mouth of the Restigouche River.
Kind of plant, sulphite-fiber pulp.
Capacity, 150 tons per day.

Boilers, Superheaters, Air Preheaters and Water Walls

Manufacturer of boilers.....Badenhausen Corp.
Type of setting .....Carl
Number 2
Heating surface, sq.ft.....8,250
Pressure, lb. per sq.in., gage.....350
Maximum steaming rate, lb. per hr.....140,000
Manufacturer of superheater.....Badenhausen Corp.
Type .....Integral
Heating surface, sq.ft.....1,595
Superheat deg. F.....200
Total steam temperature, deg. F.....650
Manufacturer of water walls.....Badenhausen Corp.
Heating surface, sq.ft.....5,300
Manufacturers of air preheaters.....Badenhausen Corp.
Type, tubular with combustion gases on the inside.
Heating surface, sq.ft.....10,000
Water columns .....Reliance Gauge Column Co.
Feedwater regulators (Copes).....Northern Equipment Co.
Soot blowers .....Vulcan Soot Cleaner Co.
Blowoff valves .....Yarnell-Waring Co.
Safety valves .....Ashton Valve Co.
Heat insulation .....Asbestos, Ltd.
Walks and gratings.....McGregor & McIntyre, Ltd.
Feed-water treatment .....Permutit of Canada, Ltd.

Pulverized-Coal Equipment

Manufacturer.....Riley Engineering & Supply Co., Ltd.
Number 3
Type .....Atrita
Capacity, each, lb. per hr.....7,000
Drive, direct, 75-hp. 880-r.p.m., squirrel-cage motor, Harland Engineering Co. Control, manual, reduced voltage, Allen West & Co., Ltd.
Pulverized coal burners; number, 2 per boiler, set one above the other.
Manufacturer .....Riley Engineering & Supply Co., Ltd.
Effective furnace volume, cu.ft. 8,600
Proximate analysis of the coal:
Volatile matter, per cent.....32.51
Fixed carbon, per cent.....52.69
Ash, per cent 11.4
Moisture, per cent 3.4
Heat value, dry basis, B.t.u. per lb.....12,575
Fusing temperature of ash, deg. F.....2,200

Stacks and Breechings

Stacks.....St. John Drydock & Shipbuilding Co., Ltd.
Material .....Steel
Number 2, diameter, 6 ft.
Height above bottom of furnace, ft.....128
Breechings constructed by.....Canadian Vickers, Ltd.

Coal- and Ash-Handling Equipment

Belt conveyors .....Link-Belt, Ltd.
Capacity, tons per hr. 50
Drive, 7½-hp. 900-r.p.m. squirrel-cage motor with push-button full-voltage control.....Canadian Westinghouse Co., Ltd.
Feeder conveyor .....Link-Belt Co., Ltd.
Drive, 5-hp. 900-r.p.m. squirrel-cage motor with push-button full-voltage control.....Canadian Westinghouse Co., Ltd.
Coal crusher .....Link-Belt Co., Ltd.
Drive, 15-hp. 1,180-r.p.m. squirrel-cage motor with push-button full-voltage control..Canadian Westinghouse Co., Ltd.
Bucket conveyor .....Link-Belt Co., Ltd.
Drive, 7½-hp. 1,200-r.p.m., squirrel-cage motor with push-button, full-voltage control..Canadian Westinghouse Co., Ltd.
Coal bunkers, capacity, tons.....500
Weighing larrys, 2.....Link Belt, Ltd.
Drive, 5-hp., 1,200-r.p.m. squirrel-cage motor with remote manual control.....Canadian Westinghouse Co., Ltd.
Ash-handling equipment .....Allen-Sherman-Hoff, Ltd.
Type .....Hydraulic
Pump on ash-handling equipment, Canadian Allis-Chalmers Mfg. Co., Ltd.
Type .....Centrifugal
Drive, 50-hp., 1,800-r.p.m. motor....Harland Eng. Co., Ltd.
Control, manual, reduced voltage.....Allen West & Co., Ltd.

Feed-Water Heater

Manufacturers .....Cochrane Corp.
One direct-contact, deaërating. Heating steam taken from 30-lb. line through reducing valve.
Capacity, lb. per hr.....138,000
Steam pressure, lb. gage.....5
Temperature of water leaving the heater, deg. F.....230

Forced-Draft and Induced-Draft Fans

Forced-draft fans 2....Canadian Blower & Forge Co., Ltd.
Capacity, sufficient to produce 150,000 lb. of steam per hour.
Drive, direct, 100-hp. 1,150-r.p.m. wound-rotor motor, Harland Eng. Co., Ltd.
Control, manual, speed-adjusting....Allen West & Co., Ltd.
Induced-draft fans, 2, M. V..Sturtevant & Co. of Canada, Ltd.
Capacity, sufficient to operate boiler at 150,000 lb. steam per hour.
Drive, direct, 125-hp., 600-r.p.m. wound-rotor motor, Harland Eng. Co., Ltd.
Control, manual, speed-adjusting....Allen West & Co., Ltd.

Boiler-Feed Pumps

Manufacturer .....Canadian-Ingersoll-Rand, Ltd.
Number, 2; type, 4-stage Cameron.
Capacity, each 250 g.p.m. against a 1,100-ft. head.
Drive, one turbine, one motor.
Manufacturer, turbine.....Westinghouse Elec. & Mfg. Co.
Steam conditions, 340 lb. gage, 650 deg. F. exhaust against 30 lb. back pressure.
Speed, r.p.m. 2,330
Horsepower 115
Motor, wound rotor, 125 hp. 1,800 r.p.m., Harland Engineering Co., Ltd.
Control, manual, speed-adjusting....Allen West & Co., Ltd.

Refuse Burning Boilers

Manufacturer .....Badenhausen Corp.
Number 2
Heating surface, sq.ft.....3,000
Pressure, lb. per sq. in. gage.....350
Maximum steaming rate, lb. per hr.....20,000
Manufacturer of superheater.....Badenhausen Corp.
Superheat, deg. F.....200
Boiler setting.....Atwood, Ltd.
Induced-draft fan.....Canadian Blower & Forge Co., Ltd.
Drive, 75 hp., 1,170 r.p.m., wound-rotor. Harland Engineering Co., Ltd.
Motor, control, adjustable speed.....Allen West & Co., Ltd.
Stack and breechings, steel.....Waterous, Ltd.
Water columns.....Reliance Gauge Column Co.
Feed-water regulators (Copes)....Northern Equipment Co.
Blowoff valves.....Yarnell-Waring Co.
Safety valves.....Ashton Valve Co.
Refuse-carrier motor, 15-hp., 1,150-r.p.m., squirrel-cage. Harland Eng. Co., Ltd.
Control, manual, reduced voltage....Allen West & Co., Ltd.

Accumulator

Manufacturer.....Ruths Steam Storage Co., Ltd.
Number, 1; volume, cu.ft., 6,200; capacity, 30,000 lb. of steam from 120 to 20 lb. pressure. Length, 45 ft.; diameter, 14 ft.
Pressure, oil pump for accumulator valves. Worthington Pump & Mach. Corp.
Drive, 5-hp., 1,150-r.p.m., squirrel-cage motor. Canadian General Electric Co., Ltd.
Control, manual.....Canadian Westinghouse Co., Ltd.

Turbine-Generators

Manufacturer .....Westinghouse Elec. & Mfg. Co.
Number, 3; capacity, 1,000 kw.; type,, two bleed at 110 lb. and exhaust at 30 lb. back pressure; one condensing.
Speed, r.p.m.....3,600
Steam conditions, 350 lb., 650 deg. F.
Condensers .....Westinghouse Elec. & Mfg. Co.
Cooling surface, each sq.ft.....1,050
Vacuum pumps, steam jet, Westinghouse Elec. & Mfg. Co.
Desuperheater .....Schutte & Koerting Co.
Desuperheater control.....Foxboro Co.
Generators, 1,250 kva., 0.80 power factor, 3 phases, 600 volts; exciters, direct-connected, 15-kw. each; one motor-driven, 15-kw. exciter.....Canadian Westinghouse Co., Ltd.
Filters on ventilating air.....National Air Filter Co.
Generator switchboard and oil switches. Canadian Westinghouse Co., Ltd.

Valves and Traps

Reducing .....Locke Regulator Co.
High-pressure .....Crane Co.
High-pressure.....Hopkinson Valve Co., Ltd.
Non-return.....Edwards Valve & Mfg. Co.
Low-pressure.....Hopkinson Valve Co., Ltd.
Traps .....W. H. Nicholson & Co.
Traps .....Farnsworth Co.

Meters and Instruments

Boiler feed water, Venturi.....Simplex Valve & Meter Co.
Steam-flow indicators.....Bailey Meter Co., Ltd.
Steam-flow, integrating.....Bailey Meter Co., Ltd.
Draft gages.....Bailey Meter Co., Ltd.
Draft gages.....Ellison Draft Gage Co.
Flue-gas analyzer.....Hays Corp.
CO_2 indicator.....Permutit of Canada, Ltd.
Steam flow, air-flow.....Bailey Meter Co., Ltd.
Pressure gages, indicating. Consolidated Ashcroft, Hancock Co., Inc.
Pressure, gage, recording.....Foxboro Co.
Indicating thermometers.....Taylor Instrument Co.'s
Recording thermometers.....Bristol Co.
Vacuum recorder.....Bristol Co.
Temperature and pressure recording.....Bristol Co.
Indicating pyrometers.....Brown Instrument Co.
Recording pyrometers.....Brown Instrument Co.
Master pressure gage on boiler.....Ashton Valve Co.
Master pressure gage on accumulator. Ruths Steam Storage Co., Ltd.

Miscellaneous

Air compressor.....Canadian Ingersoll-Rand Co., Ltd.
Drive, 75-hp., 900-r.p.m., squirrel-cage motor. Harland Engineering Co., Ltd.
Control, manual, reduced-voltage....Allen West & Co., Ltd.
On all the electrical equipment in the plant safety switches are used, supplied by the Square D Company of Canada, Ltd.

nected to a single bus. The bus is of the open type, above the oil switches, which are mounted on an open pipe-work structure. This construction allows ample room both in front and back of the switches for inspections and repairs. The feeders are run to a distribution center in each department. Here the feeder connects to an inclosed bus, to which a fused safety switch connects for each motor in the department. From the safety switches sub-feeders go to the motors, the control equipment being located near its motor. At the control there is a safety switch, and the motor is protected with overload relays as part of the control.

An outstanding feature of the plant is the extensive metering equipment, to give a complete record of the quantities of fuel and water used and the steam and power produced and their distribution. Figs. 4 and 6 show the meters and their location on the steam and water lines. These meters, combined with those on the boiler panels, allow operating the plant under test conditions at all times. The meters are in charge of a competent man who checks them for accuracy and recalibrates them when necessary. A flue-gas analyzer is connected permanently to the boiler, and daily checks are made of the flue gas. Readings of the steam-flow meter and the electrical meters in the branch lines are compared with the totalizers. If they do not check, the meters at fault are recalibrated.

Fig. 5 is a photograph of the chief engineer's meter board (shown diagrammatically in Fig. 6), which provides a record of steam and water to practically every operation and also gives the essential pressures and temperatures in those lines. This meter board is adjacent to the main switchboard, so that if any unusual demand is made on the plant, the cause can immediately be located at these boards and the fault corrected. The base of the meter board is a cabinet, with space provided for filing the charts from each meter.

Power wishes to express its appreciation for the assistance rendered in the preparation of this article by F. O. White, chief engineer, Frasers Companies, Ltd., and the Restigouche Company, Ltd., and J Mullin, power plant superintendent, Restigouche Company, Ltd.

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Causes of Rumbling and Vibration in Centrifugal Boiler Feed Pumps

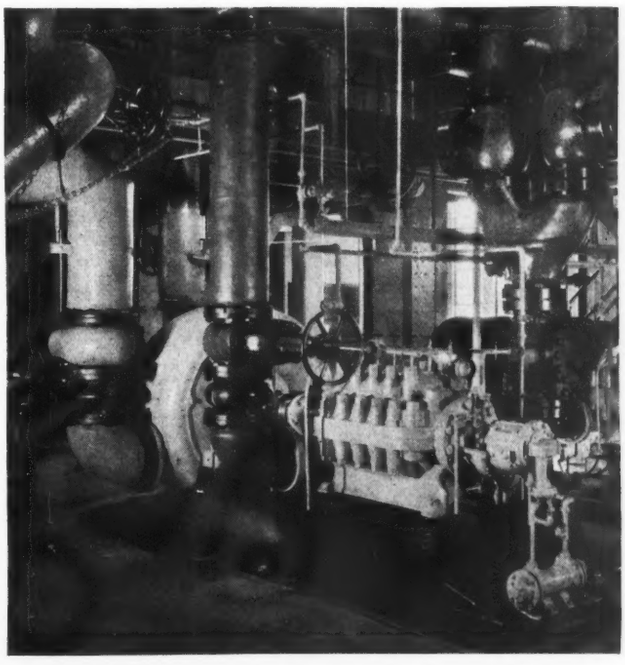
By ERNEST L. MAAG*

RUMBLINGS and vibrations in centrifugal boiler feed pumps may appear in new pumps and may be present over the whole range of discharge volume of a pump, or at certain points of the head-volume curve only. They may suddenly occur in pumps which before have run satisfactorily, without changes having been made to the pump itself or to the system of which the pump forms a part. The whole question is complex, in so far as there are a multitude of possible causes, and each individual case should be analyzed.

Centrifugal boiler feed pumps may be classified as: the volute type, Fig. 1; the diffuser type, Fig. 2; and the mixed volute and diffuser type, Fig. 3.

The first three stages of the pump shown in Fig. 3 are of the diffuser type, while the last stage is of the volute type. This design may be varied again in such a way that the volute casing is built around the diffusers of all stages, or at least around that of the last stage.

Rumbling and vibrations may be caused in any one of the three designs at certain loads by hydraulic reactions on the rotating element tending to throw the pump shaft out of line. The fact that the noises appear only at certain times would indicate that these reactions are a function of the load or of the speed of the pump. They may be present when the pump is discharging at high pressures with a throttled discharge valve or feedwater regulator, and again when the volume of water is large and the discharge pressure comparatively low. The trouble occurs most frequently at low head, and



Pumps are a major factor in plant operation

an observation of the pressure gage on the pump will soon reveal at which point of the discharge the vibrations are at a maximum.

Noise and rattling may be due to cavitation, usually resulting from wrong proportions of water passages at certain points in the pump, especially at points *a* or *b* in Figs. 1 and 2. If the areas and blade angles at these points are not designed correctly, there will be what is

*Design engineer, Babcock-Wilcox & Goldie-McCulloch, Ltd., Galt, Ont.

commonly termed "cavitation." The noise accompanying cavitation is similar to the one produced by the presence of a large number of pebbles in the water going through the pump. This phenomenon, frequently found in centrifugal pumps, is explained by the formation of partial vacua at points of disproportioned areas in the water passages through the pump, mainly between the blades or vanes in the eye of the impellers. These vacua, or hollow spaces, form and collapse in rapid succession and produce a hammering action on the impeller which, when of sufficient amplitude, will cause the rotating element to vibrate.

Another source of trouble resulting from the same causes is the edging and pitting of the blades or casing surfaces at points where cavitation takes place. The spots to look for in a pump are the eye and the edges of the blades where the water enters the impeller. Sometimes, however, the discharge portions of the impeller show signs of edging and pitting, and this is generally caused by too small areas at point *a* in Figs. 1 and 2; or by wrong angles and areas between the diffuser vanes, if the pump is fitted as shown in Fig. 2. Enlarging the free area at point *a* or reducing the areas at point *b* will often cure this trouble and stop vibrations of the shaft, which in the cases mentioned is really not the cause of the trouble but rather the result of hydraulic unbalance in the water passages of the pump.

A vibrating shaft may be due to critical speed. Especially with steam turbine drives, the speed of the unit may vary several hundred revolutions at different loads on the pump, and it may be that at one or two points of the discharge load the shaft is going through a critical speed. The remedy for this is a heavier shaft or a more accurate dynamical balancing of the rotating element. The calculation of the critical speeds according to the

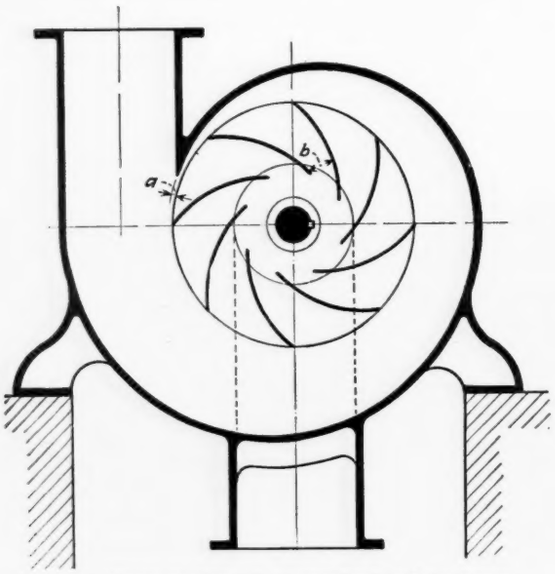


Fig. 1—Cross-section of a standard volute pump

formulas generally in use is sufficiently accurate for centrifugal pump work and a check on this point is certainly advisable.

On boiler feed pumps it is extremely important to watch the suction conditions, because if the feed-water temperature rises beyond the evaporation point in the eye of the impeller, steam will be developed, and consequently the volume of water pumped will decrease. This may have the same results as cavitation and may also cause rumblings and vibrations on the pump rotor. The same applies to air leaks on the suction line of the pump, but these are not generally found on centrifugal pumps handling boiler feed water, because these pumps work, as a rule, under a positive suction head.

The main causes for air or vapor in the pump are excessive feed-water temperature, drop of water level in the heater, air leaks on the suction or air pockets in the suction pipe. To check up on a pump on these points it is only necessary to check the feed-water temperature with several independent thermometers, or to add a small portion of cold make-up water directly into the suction pipe of the pump. If the performance of the pump improves when cold water is added, then it is certain that one of the last-mentioned causes is at the bottom of the trouble.

Boiler feed pumps have, or should have, a very flat head-volume curve, that is, the volume of water varies

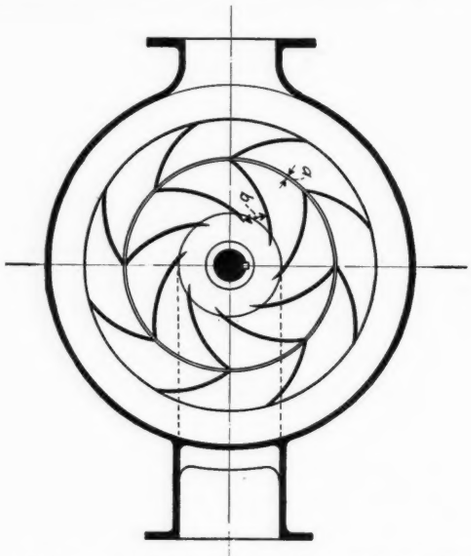


Fig. 2—Turbine pump provided with diffusers

greatly at little change of the pressure. They are therefore somewhat more susceptible to trouble, because certain pumps are correct only for a limited head-volume condition, and the farther away the operating point is from the so-called design point, the more likelihood there is of vibration. This same holds for difficulties met with when boiler feed pumps have to run in parallel and the load cannot be easily distributed among the different units. One pump, or a group of pumps, may not get its full share of the load and rumblings and vibrations may appear, just as if the pump had a choked suction. Proper load distribution among the several units is the cure in these instances.

End-thrust arrangement has to be considered, too, as a possible source of trouble, since some designs are apt to throw the shaft out of alignment. This applies mainly to the hydraulic balancing piston type of end-thrust design, and vibrations may occur after the pump has been in operation some time and wear on the balancing piston or disk has taken place.

A number of mechanical defects may be the cause of a vibrating pump shaft. Among these the most common are loose diffuser rings, as a result of the joint on the horizontally split casing being too thick. A suction passage blocked by foreign matter in the suction pipe or in

the eye of the impeller, or a partly closed valve in the line, may cause trouble. Blocked passages in one or several of the impellers will tend to throw the rotating element out of balance and cause whipping of the shaft.

Another mechanical cause of trouble may be misalignment of the shaft. It is possible that a shaft that is perfectly in line at certain temperatures will be out of true when the temperature changes. The change may be caused by variations of the temperature of the boiler feed water, or of the steam temperature when turbine drive is provided, or the room temperature may change appreciably at certain operating hours. Draft from an open door or window may be the cause.

Vibrations on a boiler feed pump may be within acceptable limits when the unit is in normal service but they may become excessive as soon as another machine in the same or in an adjoining room is started up and the frequencies of the two units are in step.

On the closed type of feed heaters, the back pressure of the steam turbine driving the pump may be used for feed-water heating. Owing to process-steam demands, this back pressure may vary or surge and at certain times prevent the feed water from flowing into the heater. Then the pump may temporarily pump the heater dry or partly lose the water, which, of course, will produce similar effects as those described under the discussion on cavitation and vapor binding. To remedy this trouble it is necessary to raise the pressure of the feed water entering the heater or to install a vacuum type of heater.

On boiler feed pumps it is extremely important to watch the suction conditions. A static head of 12 to 15 ft. over and above the pressure of evaporation is advisable. Any pockets in which air or vapor could be trapped have to be avoided on the suction side of the pump. Glands and petcocks must be tight when working under a suction lift. The pump must at all times be kept in good mechanical repair. Sleeves, shafts, journal and thrust bearings, seal rings and diffusers must be replaced when they show signs of wear or the internal leakages in the pump may become so great that the pump cannot maintain the designed head pressure.

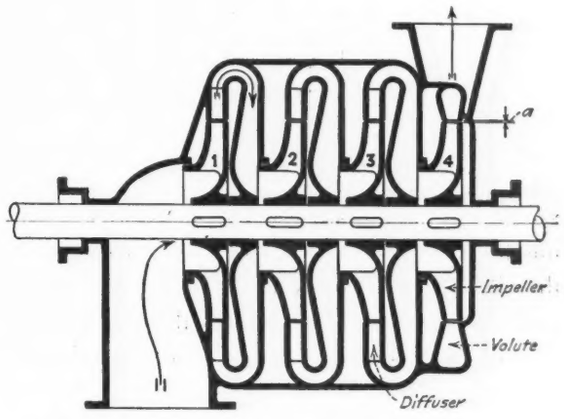


Fig. 3—A multi-stage pump of the boiler-feed type

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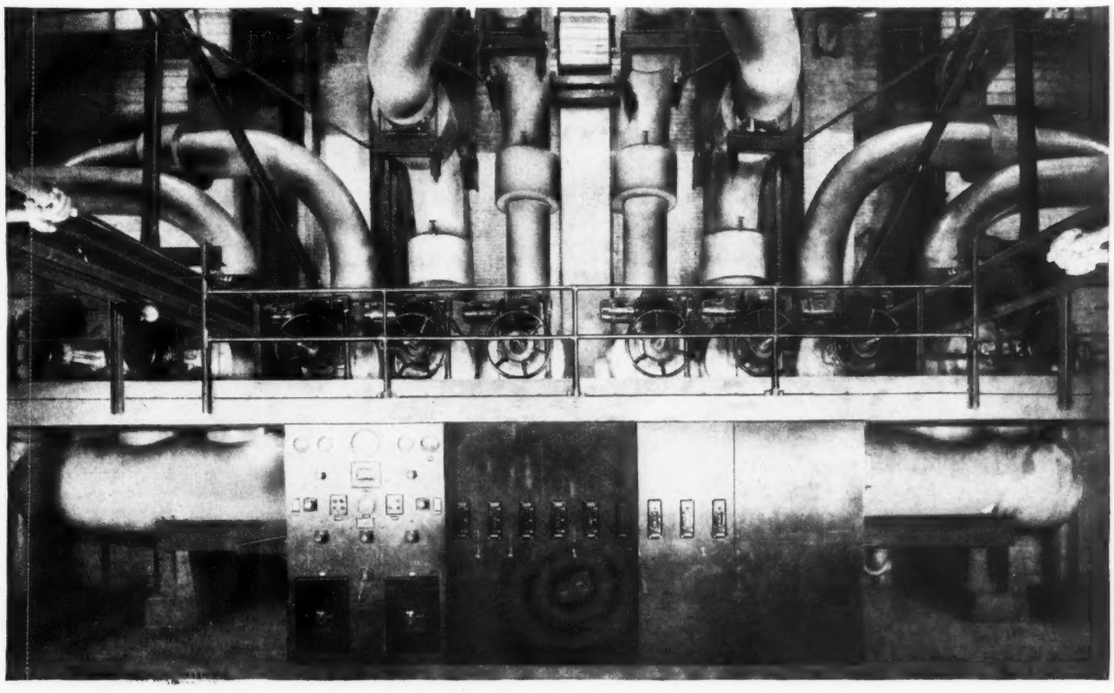
CONCENTRATED VALVE CONTROL

COLLECTING the steam from six boilers and supplying it through four leads to the 208,000-kw. turbine-generator at State Line station of the Chicago District Electric Generating Corporation provided opportunity for a very compact installation of motor-operated gate valves with remote control. Ten 14-in. lines enter or leave the large forged-steel steam separator header or manifold designed to withstand a pressure of 800 lb. The contactors are mounted in a steel cabinet on the boiler room floor immediately in front of the header, and on the front of this cabinet are the push-button valve controls.

Photo Courtesy of Cutler-Hammer, Inc.



Mechanical-Type VARIABLE-SPEED TRANSMISSIONS—I

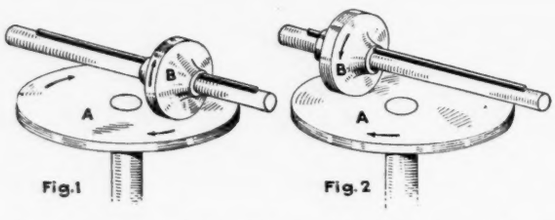
The first of four articles on variable-speed transmissions. The first three will be descriptive of the different types available, both mechanical and hydraulic. Application of this equipment will be the subject of the fourth article.

By F. A. ANNETT
Associate Editor of POWER

MANY industrial-power applications require adjustable speed. Where this can be obtained by adjusting the motor's speed, it is generally the preferred method. Direct-current motors offer wide possibilities for speed adjustment by comparatively simple means. This, however, is not true of alternating-current motors. The simple squirrel-cage type is inherently a constant-speed machine. The wound-rotor type's speed can be reduced to about only 50 per cent of maximum. This is inefficient, the number of speed adjustments is limited to the number of contact points of the regulator, and the speed is not constant for any particular adjustment unless the load is constant.

Multi-speed squirrel-cage motors are used, but are usually limited to two speeds, such as 900 and 1,800 r.p.m. Multi-speed wound-rotor motors are sometimes used, but the motors and their control are complicated and expensive and the motor's characteristics are inferior to the single-speed squirrel-cage or wound-rotor motor. There are types of alternating-current motors that allow close adjustment of their speed over certain ranges. These motors are complicated and their speed range is limited. For these reasons there is a wide field of power applications where alternating-current motors cannot meet speed-adjustment requirements and some type of mechanical variable-speed transmission must be used.

Even when it is possible to use an alternating-current motor to give the necessary speed adjustment, the expense and complications of doing it may make a simple constant-speed motor with a variable-speed transmission a more desirable application. With direct current it is possible to obtain any speed range, but even here the cost of obtaining it may make the mechanical variable-speed transmission equipment with a constant-speed motor the more economical proposition. From the foregoing it is evident that there is a wide field for mechanical variable-speed transmissions.



Figs. 1 and 2—Friction-disk variable-speed transmission

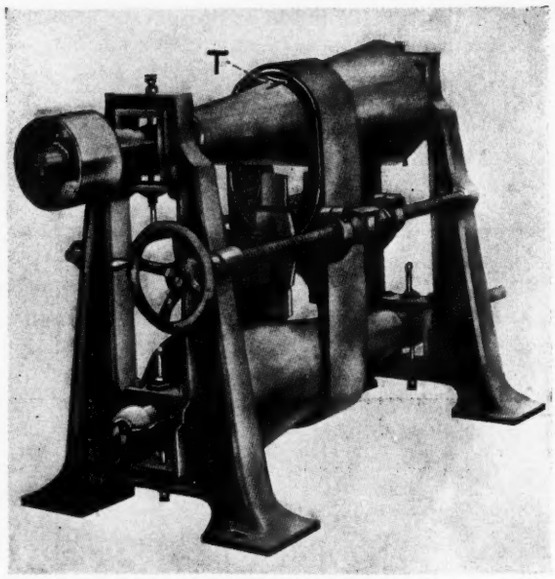


Fig. 3—Moore & White parallel-cone-pulley type of variable-speed transmission

Step pulleys with belt-shifting devices and gear-changing equipment have been and are being used to obtain changes in speed. Such devices give speed changes in steps that are so large as to be unsatisfactory for close regulation. There are, however, many places where such devices are used successfully, either with constant-speed or adjustable-speed motors. There are several types of equipment that will provide speed changes in small increments in an infinite number of steps. These equipments include:

(*a*) Sliding friction disks.
(*b*) Parallel cone pulleys connected by a belt that can be shifted along the cones.
(*c*) Adjustable V-shape pulleys connected by a belt and provided with a mechanism for adjusting the diameters of the pulleys.
(*d*) A variable-speed unit with either (*b*) or (*c*).
(*e*) Adjustable friction-cone drive.
(*f*) Constant-throw eccentrics with variable-throw clutches.
(*g*) Variable-throw eccentrics and clutches.
(*h*) Hydraulic types.

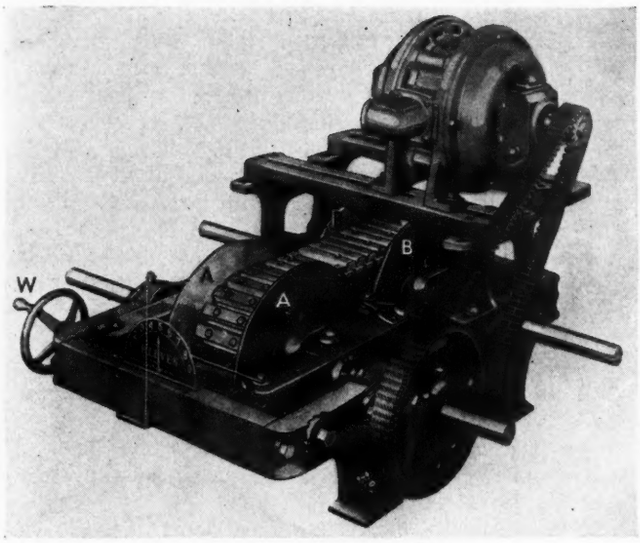


Fig. 4 (Left) — Reeves horizontal type of variable-speed transmission using V-shaped pulleys connected by a lagged belt and provided with a mechanism for adjusting the diameter of the pulleys

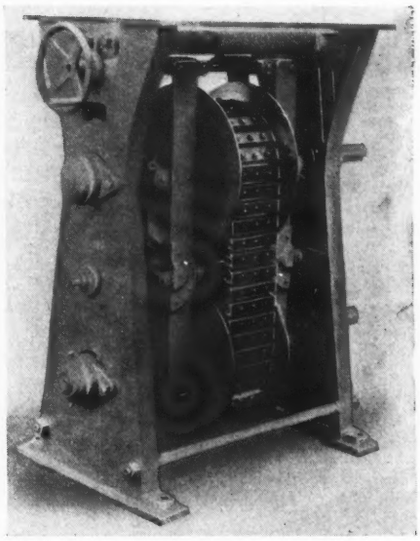


Fig. 5 (Right) — Lewellen vertical-type variable-speed transmission with V-shaped pulleys

In this article only the first four mechanical types will be considered, a future article will deal with the other three mechanical types and another will describe the hydraulic types.

One form of the sliding friction-disk type is shown in Figs. 1 and 2. The two disks are at right angles to each other. Disk *A* is driven at constant speed, and *B*, the variable-speed unit, is arranged to be moved along its shaft on a key. When disk *A* revolves it turns *B* by the friction between the two. With *B* in the outer position it will revolve at its maximum speed. If *B*'s path of contact on *A* is equal to its diameter the two disks will revolve at practically the same speed. When disk *B* is moved on to the center of *A* its speed will be zero and it will only describe a point of contact on *A*. By comparing the direction of the arrows on Figs. 1 and 2 it will be seen how *B* is reversed when shifted from one side of *A* to the other. Speed changes from zero, with *B* at the center of disk *A*, to a maximum, in either direction with *B* at the outer circumference of disk *A*, may be obtained. This type of drive is not very generally used in industrial power transmission except in small sizes built in as part of a machine or control equipment.

A type of variable-speed transmission device that has found wide application is shown in Fig. **3.** As can be readily seen, this drive consists of two cone pulleys of equal size, set parallel, with the cones pointing in opposite directions. The pulleys are connected by a belt. Under the belt, the surface of each cone is built up from conical to cylindrical form by a cone-pulley transformer *T*. The transformer consists of a series of tapered leather strips riveted on to an endless belt.

One of the cone-pulley shafts is connected to the source of power and the other to the driven machine. With the power-input cone operating at a constant speed, the speed of the output cone is varied by shifting the belt along the pulleys. The belt shifting is done by moving the transformers along the cones, without stopping the machine, by a screw and handwheel mechanism attached to the inner ends of the transformers. Driving belts of ordinary width and thickness are used, and the speed can be adjusted to any degree of refinement. The maximum speed range for which this type of drive is built is about $3\frac{5}{8}$ to 1, in sizes up to 200 hp. The units may be made

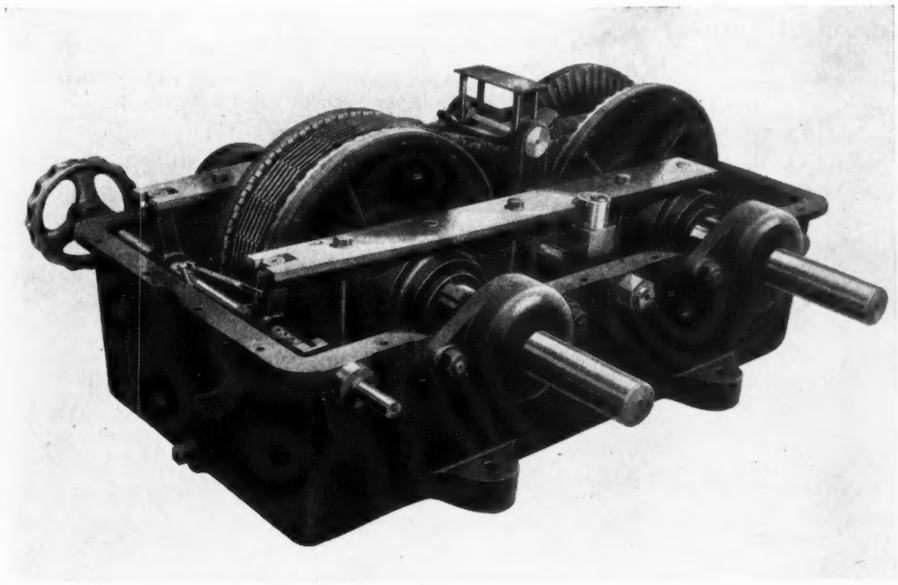


Fig. 6—Link-Belt variable-speed transmission using a laminated-steel toothed chain between cone-faced pulleys

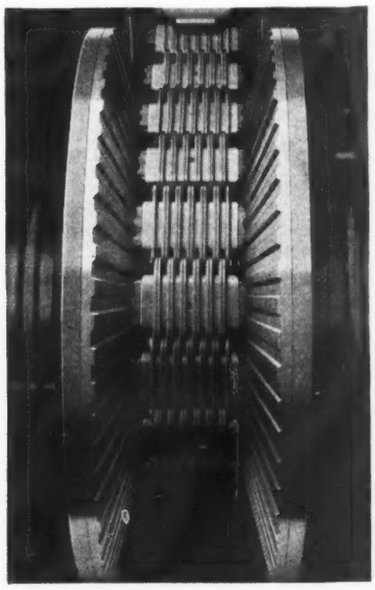


Fig. 7—Tooth formation in chain, Fig. 6

up complete with the driving motor on a base or the variable-speed units may be had separately for belt or other forms of drive.

In the variable-speed transmission, Fig. 4, two pairs of conical-faced disks, doubly splined and mounted on parallel shafts and connected by a V-shaped belt, form the means of adjusting the speed. The V-shaped belt fits the throat between the two pairs of disks. The diameters of the belts' tread on the V-shaped pulleys can be adjusted by shifting levers that separate one pair of disks and bringing together the other pair. In Fig. 4, when disks *A* are separated disks *B* are brought together. This operation allows the V-belt to ride farther down between disks *A* and cause it to run farther up in disks *B*. The effect is to decrease the diameter upon which the belt runs on *A* and increase it on *B*. Therefore if *A* runs at a constant speed the speed of *B* will be decreased. Reversing the operation, bringing disks *A* together and separating *B*, the speed of the latter will increase. The speed changes can be made with the transmission running under load.

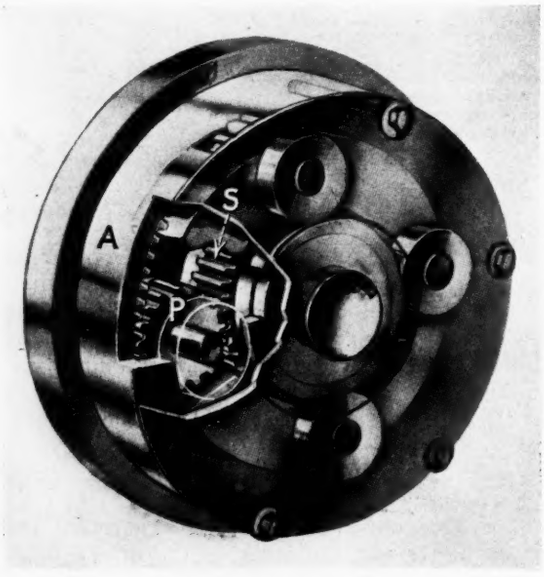


Fig. 8—Bronander variable-speed unit of the Spadone Machine Company

These transmissions are built for speed ranges of from 2 to 1 to 16 to 1, in sizes from fractional horsepower to 50 hp. The shaft in either of the V-shaped pulleys *A* or *B* may be connected to the source of power and the other to the load; the driving and the driver connections may both be on the same side of the machine or one may be on one side and one on the other. Ordinarily the change in speed is obtained by manually operating the handwheel *W*, Fig. 4. The speed may also be controlled from remote points either electrically or mechanically. For many special requirements various types of automatic control have been developed that eliminate the need for an operator.

The units are built in horizontal types, Fig. 4, and vertical types, Fig. 5. They are made as separate units and with various types of speed-reducing drives. Or they may be had with the motor mounted directly on the unit, as in Fig. 4. They are ordinarily built in the open type, but may be had entirely inclosed for use in dirty places or in severe atmospheric conditions.

The V-belt on the variable-speed transmission, Fig. 4, is made of a high-grade rubber with a row of hardwood blocks bolted to each of its surfaces. The ends of the wood blocks are tipped with a special tannage leather to give a high coefficient of frictional contact against the cast-iron driving disks. After the V-belts are assembled they are run through a machine that shapes the leather tips to the exact contour of the disks, so that every tip makes contact with the disks' surfaces.

The speed-change unit of the variable-speed transmission, Fig. 6, consists of two pairs of opposed conical disks between which a special type of chain transmits power. The tread diameter of the disks, on which the chain runs, is changed in much the same way as explained for Fig. 4, and the speed change can be made with the transmission running under load. On changing speed the chain rises between one set of disks and descends between the other, so that while the input power shaft operates at a constant speed the output shaft speed is varied to the desired values.

Radial teeth are cut in the conical faces of the driving disks. There are no teeth on the inner surface of the chain; instead what may be called teeth are made of packs of hardened-steel laminations that extend through the links at right angles to them and project about $\frac{1}{8}$ in.

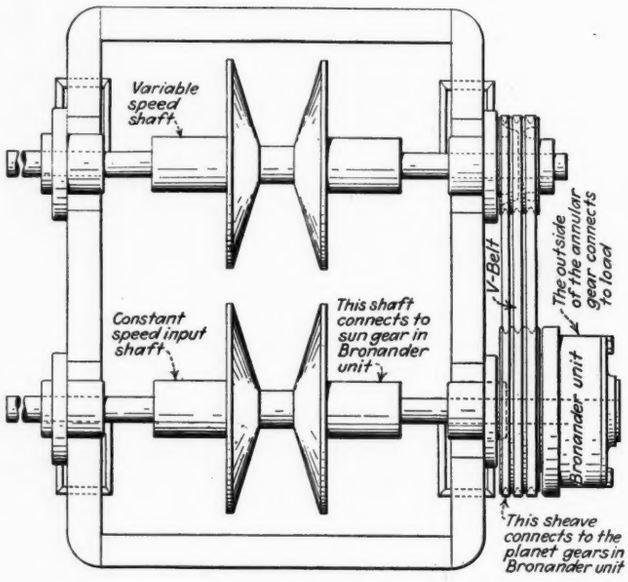

Variable speed shaft
V-Belt
The outside of the annular gear connects to load
Constant speed input shaft
This shaft connects to sun gear in Bronander unit
Bronander unit
This sheave connects to the planet gears in Bronander unit

Fig. 9—General arrangement of a variable-speed transmission and the variable-speed unit Fig. 8

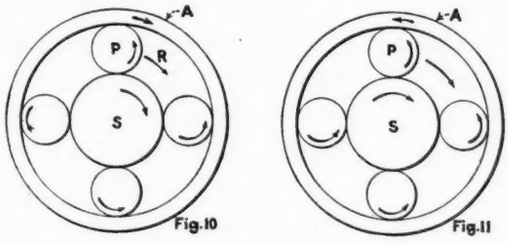
at each side of the chain. The individual containers, which hold the packs of laminations, are secured in openings in the links, but the laminations are free to slide endwise and adjust themselves to engagement with the radial teeth of the disks over substantially the full range of diameters. The angle, 30 deg., of the slant ends on the laminations is the same as that of the conical faces of the disks. The teeth are so staggered on each pair of disks that the laminations move back and forth into the teeth as the chain comes into contact with the wheel. How this adjustment is made is indicated in Fig. 7, which shows how the laminations fit the teeth at the inner diameter of the disks. In this figure the tooth formation is shown on the minimum diameter of the toothed conical disks.

All elements of this variable-speed transmission are built into an oil-tight housing and are automatically splash-lubricated. The units are made in sizes of 5 to

10 hp. capacity and for speed-change ratios up to 6 to 1. Normally the speed change is made manually by turning a handwheel on the outside of the inclosing case, but either remote or automatic control may be had.

Fig. 8 shows a Bronander variable-speed unit for attaching to variable-speed transmissions of the types described in Fig. 3 to 7. It consists of a planetary gear arranged so that the sun gear *S* and the planet gears *P* are driven from the variable-speed transmission and the annular gear *A* is connected to the load. The planet gears rotate and are fastened in a spider.

The general arrangement of the unit on a variable-speed transmission is shown in Fig. 9. The sun gear is keyed to the input shaft of the variable-speed trans-



Figs. 10 and 11—Show the principle of the variable-speed unit Fig. 8

mission. The planet gears are connected by a V-belt or chain drive to the variable-speed output shaft of the variable-speed transmission, and the annular gear may be connected by any means to the load.

The action of the variable-speed unit will be made clear by considering Figs. 10 and 11. Assuming the annular gear *A* to be stationary, the sun gear *S* rotating in a clockwise direction and the planet gears *P* free to rotate, the spider holding the planet gears *P* would rotate in a direction indicated by the arrow *R* in Fig. 10. This condition would also exist if the planet gear's spider were driven at the same rate of speed as when free. By increasing the speed of the planet gears the annular gear *A* will rotate in the same direction as the sun gear *S*. By decreasing the speed of the planet gear's spider the annular gear will rotate in an opposite direction, as in Fig. 11.

The foregoing is what takes place in the unit, Fig. 9. When the variable-speed transmission is so adjusted that the planet gear's spider, driven by the output shaft, has the same speed as the sun gear driven by the input shaft, the annular gear, which is connected to the load, is stationary. By adjusting the variable-speed transmission so that the speed of the planet gear's spider is greater than that of the sun gear the annular gear will rotate in the same direction as the sun gear. When the variable-speed transmission is adjusted so that the speed of the planet gear's spider is slower than that of the sun gear the annular gear will rotate in a direction opposite to that of the sun gear. From the foregoing it is seen that the variable-speed unit, Fig. 8, allows extending the speed range of a variable-speed transmission to zero and in either direction in infinite steps. These units run in oil and can be had in sizes to suit the standard ratings of variable-speed transmissions.

Although the ratio in speeds of the Bronander variable-speed unit is infinite, the maximum speed is limited by two factors: The speed range of the variable-speed transmission used, and the ratio of the V-belt pulleys or chain sprockets connecting the variable-speed shaft of the transmission to the variable-speed unit. When calculating the driving speeds, any desired range may be obtained by varying the ratio of the pulleys or sprockets from the Bronander unit to the machine to be driven, and still maintain the zero feature.

As an illustration, assume a machine is to be driven from zero to 1,200 r.p.m. forward. A variable-speed transmission with a ratio of 4 to 1 may be used, the constant speed being 400 r.p.m. With the V-belt pulley ratio of 1½ to 1, the variable-speed unit will give a range in speeds from zero to 600 r.p.m. forward. If, then, from the variable-speed unit to the driven machine a pulley or sprocket ratio of 2 to 1 is used, the driven machine will run from zero to 2×600, or 1,200 revolutions per minute.

Individual problems may be similarly solved merely by selecting the proper pulley or sprocket ratio from the variable-speed unit to the machine to be driven. By adopting different V-belt pulley or sprocket ratios, the variable-speed unit can be made to cover a wide range of speeds from zero in either direction.

For assistance in the preparation of this article the author wishes to thank the Moore & White Company, Philadelphia, Pa.; Reeves Pulley Company, Columbus, Ind.; Lewellen Manufacturing Company, Columbus, Ind.; Link-Belt Company, Chicago, Ill., and the Spadone Machine Company, New York City.

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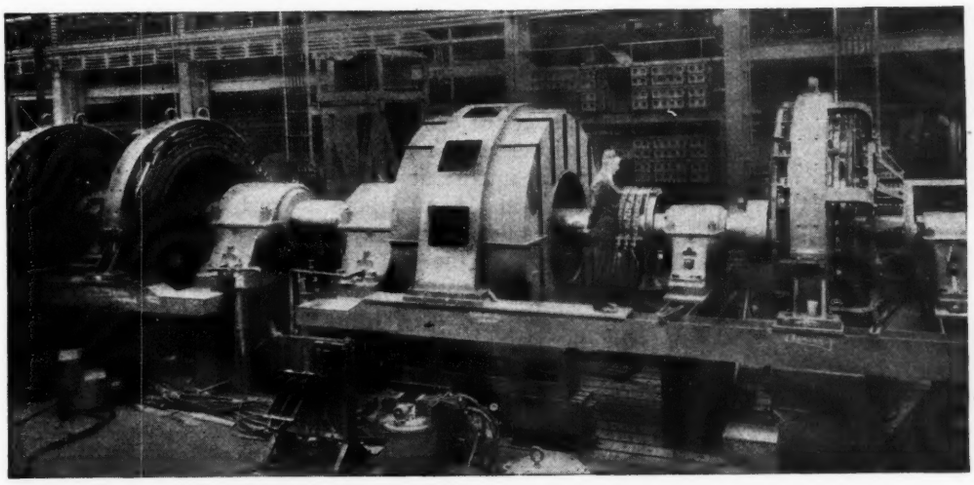
TESTING A 9,000-KW. MOTOR-GENERATOR SET

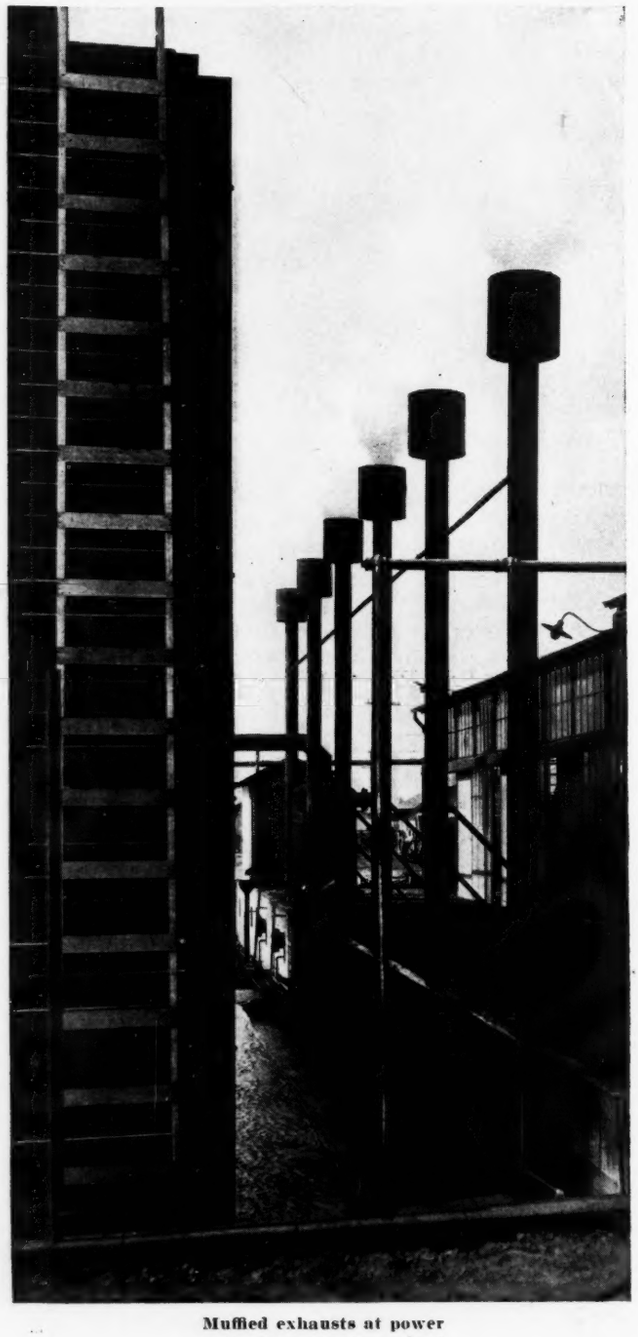


The largest motor-generator ever built to supply power to motors driving a blooming mill, shown on test in the East Pittsburgh works of the Westinghouse Electric & Manufacturing Company. It consists of three 3,000-kw. generators and a 6,500-hp. induction motor, and it will furnish the power for two 5,000-hp. double-unit reversing motors for twin drive on a blooming mill. The flywheel is 15 ft. in diameter and weighs 180,000 pounds

GAS COMPRESSOR PLANTS: Suggestions for Their Design and Construction

Based on the actual experience of the author, this article is entirely practical in aim and content. It tells how to build for safe and dependable operation with low maintenance and adequate provision for expansion. The numerous suggestions included refer primarily to gas compressor plants, but many of them apply to air compressor plants as well

By M. C. COCKSHOTT
J. B. Gill Corporation



Muffled exhausts at power end of compressor plant

IN THE design of modern compressors plants much thought and study is given to maintenance cost and operating efficiency. Another point—just as important, but frequently overlooked—is adequate provision for future expansion.

A serviceable building may be erected of fabricated steel construction covered with galvanized corrugated iron or asbestos lumber. While the corrugated asbestos lumber is more expensive, it is an ideal heat insulator, is weatherproof and fireproof and has a salvage value if the building is wrecked or subjected to a fire.

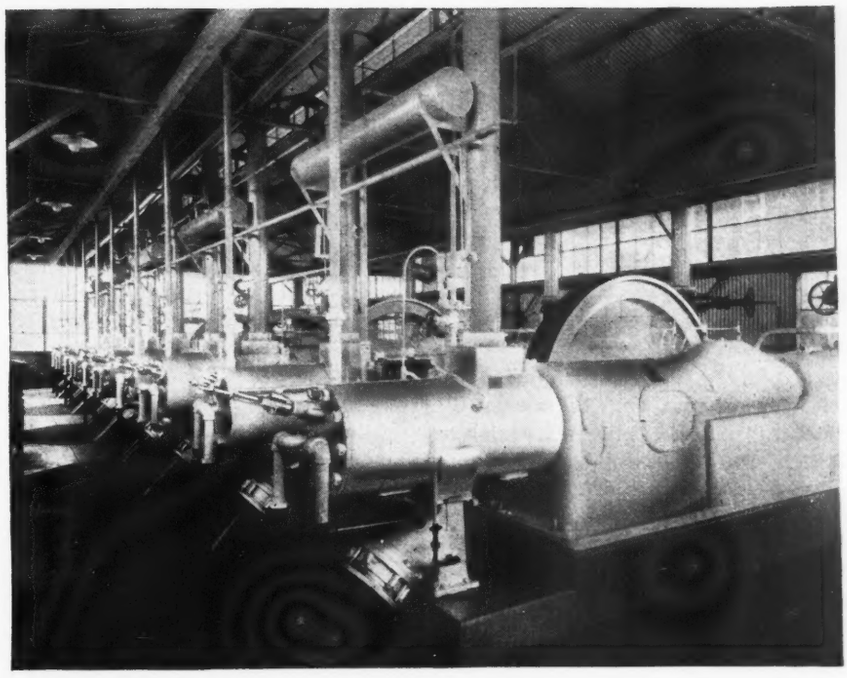
A compressor house for the standard 180-hp. types of compressor is usually about 32 ft. wide, leaving room for pulling pistons at both power and compression ends.

Ample Light and Safe Ventilation

Adequate light, both natural and artificial, is important. Wire-reinforced windows and skylights provide protection against flying glass in the event of machine accidents. Electric lights should be installed at each end of the building—also over the sliding doors installed at the ends of each machine.

Roof ventilation for the removal of fumes and vapor is equally important. Rotary ventilators are frequently used, but in a plant where a fire hazard exists are not as good as the louvered type. These louvered ventilators should extend the full length of the building.

When gas or fumes catch fire they are drawn toward the ventilators. If these are of metal they melt with the intense heat. The resulting collapse cuts off the draft and allows the flames to fan out over the machinery. With wooden louvres, on the other hand, the wood burns out and the flames are drawn up and out through the resulting openings. This confines the fire



Interior of modern gas compressor plant. Note neat arrangement of equipment with ample light and ventilation

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to one spot until the gas supply can be turned out.

Pipes in floor trenches should be so laid that all flanges are easily accessible. Such pipes should be neatly covered with floor plate rather than with grating, which allows dirt to fall into the trenches. The floor plates should be pitched so that all water and oil can be run off into the main plant drain.

Underground pipes should be well painted with a bitumastic paint and wrapped with a specially prepared paper-like fabric that is more or less corrosion proof. The practice of painting and wrapping with burlap is not so good, because the burlap will rot off in a short time and leave the paint unprotected.

In the installation of piping, attention must be given to accessibility, also to future extension. The pipes should be of sufficient capacity to allow for plant growth. Block valves should be placed at the ends of runs so that additions may be made without a shutdown.

Three Ways to Turn a Corner

Three methods are used for carrying a pipe around a corner: A standard flanged or screwed fitting, a pair of welded 45-deg. angles or a "tube turn" (a pipe bent 90 deg. on a short radius for welding into the line). For looks the fittings or tube turns are probably the best, but two 45-deg. welds answer the purpose where a cheaper job is required or where the pipe is to be buried.

In installing valves the bonnets should be lifted after the installation has been run for a time, and all dirt, bits of welding rod, etc., that may have lodged in the seat space of the valve removed. This is especially important in the case of gate valves.

Where high-pressure air or gas is in the lines all the screwed joints of flanges, etc., should be seal welded with an arc-welding machine to insure absolute tightness.

Lines carrying water or other liquids should have suitable air relieving vents at the high points and drains at the low points.

The unit system of compressor plant, which is a specialty with the author's company (J. B. Gill Corporation), is designed particularly to simplify maintenance. Each compressor with its component parts (fuel, water, suction, discharge and cooling sections) is so constructed that any unit can be shut down or cut out and removed without affecting the rest of the plant.

The suction headers for water and fuel run the length of the building and supply each machine through a down drop with valves. There are individual discharge lines to the cooling tower so that the gas or air for each machine may have its own individual cock.

Pipe Trenches and Mufflers

If practicable, piping should be run in a trench outside the building, with all valves accessible and with sufficient space between pipes so that they may be removed or worked upon. Some trenches are covered with checker plate, but for a main header pit or manifold pit they are best left open, with handrails and steps if needed.

Where the compressor is gas-engine-driven, as is common practice in the oil fields, the muffler design is of importance, as often the compressor is so placed that the noise must be reduced to a minimum. It is easy to baffle the exhaust gases to a point where considerable back pressure is set up. By suitable muffler design, combined with the right size of exhaust stacks, this can be overcome.

The practice of putting in a drain that blows into the muffler pit is to be condemned. This drain, which takes care of the water run into the exhaust, should be connected through a swing joint to the plant drain. If blown into the pit the hot water may crack the concrete and scour out the pit foundations, causing them to settle.

Sand Jacket Helps to Deaden Noise

If placed in a pit, the mufflers should not be anchored to the floor, but held loosely with lugs having slotted holes to take care of the expansion and contraction. Sometimes the muffler and exhaust are vertical and above the engine. Here, if practicable, a sand jacket, held in place by an extra covering some 12 in. larger in diameter than the muffler, helps to deaden the noise.

Gages look best and are freest from vibration if placed on a neat wall gage board. A good practice is to equip each gage with a drip baffle to protect the delicate mechanism from entrained oil and water.

Water-circulating pumps are usually installed at the

end of the building. If of centrifugal type they are generally placed in a pit so that the suction pressure is positive. This pit must be railed off with a toe board or curb, also drained to a point where a sump is built in. The sump may be cleared through a small pipe and valve hooked into the suction of the pump.

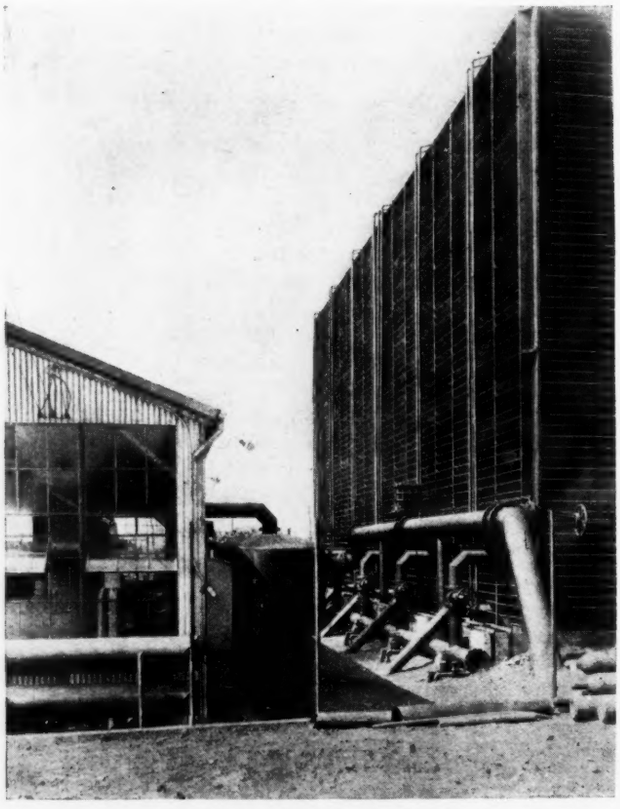
Where a closed system (or treated-water system) is used it is usual to have three pumps: one for the closed water through the engine jackets, one for the water over the tower, and the last a stand-by that can be connected to either service.

On the jacket-water pump it is a good plan to bypass the suction into the discharge, as often less water is needed in the jackets than the pump will handle.

There are two ways of running the circulating water. One is from the pumps through the cooling section, then to the jackets and so to the pump suction. With this arrangement an overheated engine is apt to steam bind the pump suction, but this can be avoided by running the water from the pump to the jackets and from them through the cooling coils and so to the pump suction.

Cooling Towers and Coils

Cooling towers of many designs are available. However, builders of compressor plants should buy towers



Discharge side of plant showing closed - louvre cooling tower

made by manufacturers who have specialized in this type of equipment. for there are many factors that have to be considered. In the design of cooling equipment on a compressor plant it is safe to allow 100 g.p.m. through the jackets of a 180-hp. engine. If a closed system is used 25 per cent more will be required to cool this water about 35 degrees.

The cooling coils can be made of return bends. If the coils are used for cooling gas they should be of a type that can be opened up at the ends for cleaning purposes and be blown out with live steam. There are many types of coils in the market, so that it generally does not pay to make them up.

Air-Starting Units

The air-starting unit is usually in the auxiliary bay of the building and may be either gas- or electric-driven. The air is pumped into a tank—usually made from 16 in. x 10 ft. pipe welded with orange-peel heads. These should be tested to 500 lb., and are usually run up to about 200 lb. They are equipped with safety valves and gages. All fittings on this installation should be for 250 lb. working pressure throughout.

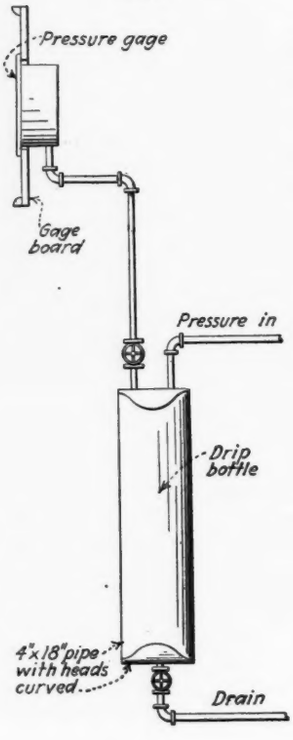
If the compressors are gas-driven the fuel line should hang in the eaves of the building. Gas is led from this leader through a pressure regulator to a tank placed above the power cylinder. This can be made of 8 in. pipe 8 ft. long. It is often carried on brackets welded to the air breather pipes above the engines.

The regulator, of an approved type, must have valves on both sides, also unions, so that it can easily be removed for repairs. Circulating-water lines to the engines should use globe valves for closer control of water flow. In other parts of the plant gate valves are the best, as they are less likely to cut through by wire-drawing.

Due foresight in design and construction will reduce the maintenance of a compressor plant to a minimum. With the machines themselves—whether gas-, electric- or steam-driven—constant care is needed because of the continuous operation under full load.

The compressor parts that give the most trouble are the valves and piston rings. One way to increase their life is to remove, so far as possible, suspended oil or water drops. There are many types of scrubbers for this purpose. A common type is made from a round tank usually about 4 ft. diameter and 10 ft. high. The incoming gas is admitted tangentially and whirls around, throwing the matter in suspension to the bottom, where it is drained off.

Gages should be provided with drip bottle to protect mechanism from entrained oil and waste



COAL DUST RECOVERY at Toronto Station

By W. S. JOHNSTON[1]

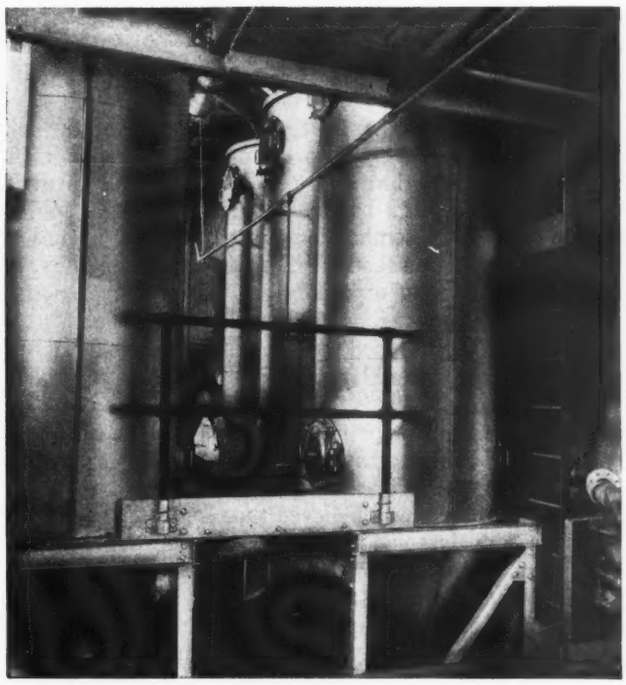
THE RECLAMATION of impalpable particles has been successfully accomplished in a number of instances where they otherwise would be discharged into the atmosphere through the vents from coal-preparation equipment and in the waste gases emitted by steam-electric generating stations. The subject is one of ever-growing importance to the electric utility companies, not only those adjacent to centers densely populated, but wherever people live or carry on productive efforts. One of the Eastern states recently enacted a law requiring the use of equipment that will obviate such a nuisance in all power plants built in its metropolitan district after Jan. 1, 1931. To enforce the law more effectively there is required the submission for official approval of detail plans and specifications of the equipment proposed to collect, or prevent the discharge of, the solid particles.

Many devices have been developed to cope with the problem: the cyclone separator, either alone or in conjunction with an induced-draft fan; numerous eliminators, traps or catchers depending on reversal or deviation of the medium flow for expelling and depositing solid matter; cloth filters and electrostatic precipitators. The success of these is measured by the degree in which they will collect extremely small particles of the order of 300 mesh and less. Their success is largely a function of the medium velocity. The particles are so minute that, unless the air or gas velocity is such that they have an opportunity to settle out, they will be carried along with the medium. This is quite evident in the case of the cyclone separator, where high velocity would permit of little recovery of impalpables, and is true in some degree of the other types of devices.

The use of efficient recovery equipment presents a real problem to the power plant designer, for to be efficient necessitates that its bulk be large because of the inherent low medium velocities that must be used. But it is a problem that will have to be met frequently in the future as sentiment against public nuisances mounts and the law makes obligatory the use of preventive means. The manner in which this problem was solved in one instance is here described.

The Toronto, Ohio, station of the Ohio Edison Company, formerly operated by the Pennsylvania-Ohio Power & Light Company, is one of the original large plants employing pulverized fuel. It was laid out for the storage system, with one pulverizing mill and its attendant exhauster and cyclone for each of the original four boiler units. Initially it was planned to use local strip mine coal, just as it was shoveled out of the ground, supplemented by Pittsburgh coal. After the first (1925-26) winter's operation the addition of coal dryers was deemed essential because of the high moisture content of the strip mine coal, accentuated by winter snow and ice accumulated during transportation. Then began a series of experiences with various types of dryers, starting with those of the stationary steam grid type, next the waste gas type and finally the rotary steam grid type.

About a year or two later there had been installed and successfully operated elsewhere direct systems of firing pulverized fuel wherein drying of the coal was accomplished by supplying heated air to the mill. This air was

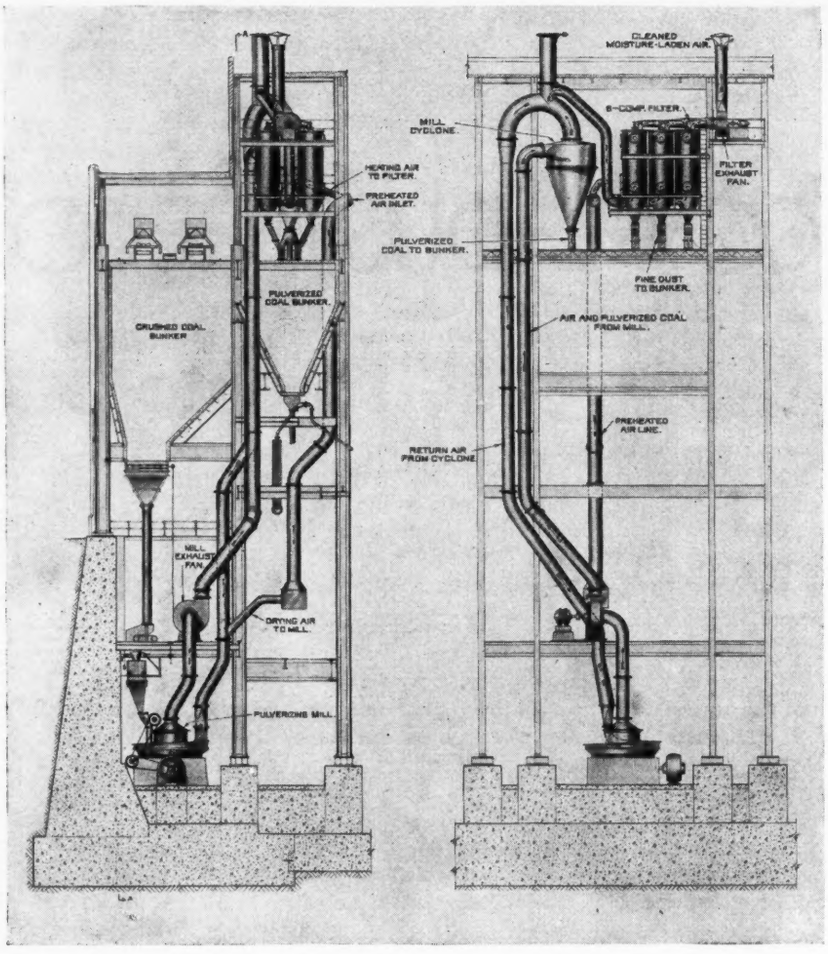


Insulated and sheathed compartments house the bag filters

[1]Mechanical engineer formerly with Allied Engineers, Inc., New York, N. Y.

supplied under pressure and drawn off by an exhauster discharging directly to the burners. It fulfilled the fourfold function of drying the fuel, separating the pulverized coal in the mill, transporting it to the burners and furnishing the primary air required for combustion. The success of this method of drying coal suggested its use in conjunction with the storage system of firing at Toronto.

Originally the mill cyclones were vented individually into the respective boiler stacks. This procedure resulted in a dark gray discharge of coal-laden air into the atmosphere from the stack of a cold boiler when its mill was in operation and led to an appreciation of the amount of solid carbonaceous matter thus lost from the coal pile. When mill drying was inaugurated it seemed economically essential that the vented air be retained and used for combustion, as its temperature was above that of the boiler house and it was known to contain much combustible material. It was then proposed to supply secondary air under the forced-draft fan pressure to the mill through the cyclone return air line just ahead of the mill, and above this point to take off the same quantity of air by the primary air fan and deliver it to the feeders.



Sections through coal preparation equipment, showing arrangement of dust-recovery filters

This method was entirely successful, the coal was dried to a low degree of moisture content, it conserved former fuel losses and removed a nuisance to the public. However, there was one undesirable feature. In the original plant design the primary air fan suctions and discharges were all manifolded to provide flexibility of operation. The impalpable coal dust settled out of the air in both manifold ducts in obscure and inaccessible locations, defying effective and total dislodgment by any system of steam- and air-agitating nozzles or jets.

Investigation of other means of disposing of the mill vents led to the suggestion of an auxiliary burner in the front furnace wall, but local conditions did not favor its use. Further, such a burner could not be made subject to the automatic combustion-control system in use at Toronto, and it was thought it would lead to high excess air in the furnaces, especially at light loads. Another idea was to introduce it as tertiary air in the regular burners, which were equipped to use it around the burner barrels, but again it could not be automatically controlled. Both of these expedients would have required a considerable investment in fan equipment, and, because of lack of space, would have led to a congestion of equipment, thus handicapping operation and maintenance work.

Early in 1929 it was believed that bag filter equipment would effectively solve the problem by thoroughly cleaning all of the vent air as well as reclaiming the coal. Examination of similar applications revealed, in one particular instance, the complete eradication of an obnoxious situation where the complainants were the residents of an exclusive island colony across the river from a large pulverized-fuel-fired plant. Therefore, it was decided that for Toronto an experimental installation of filter equipment would be undertaken.

Filter rates were slightly increased over conservative design figures already empirically known to be satisfactory for the filtration of coal-laden air. Each mill system requires the circulation of 17,000 c.f.m. of air. From previous experiences it had been determined that the withdrawal of 10,000 c.f.m. of air from the system was sufficient for drying the coal. This amount was then used as the basis for calculating the filter equipment required. Each section is made up of eighteen bags affording 330 sq.ft. of effective filtering area. Using a filter rate of 6 c.f.m. per square foot of area indicated that five sections were sufficient. However, the effectiveness of cloth filter bags depends largely upon their dryness while in operation, and as it was known the air to be cleaned was laden with moisture accumulated in the mill it was necessary to investigate thoroughly its temperature and humidity.

As a result of a series of tests it was found that the average filter temperature would be 125 deg. F., with a possible 20-deg. drop in air temperature through the filters, while the dew point of the air was 110 deg. Thus, to raise the dew point it would be necessary to add preheated air to that from the mills before passing through the filters, and, based on experience, 15 per cent of the total volume was the amount selected. There would be then a mixture of 8,500 c.f.m. at 125 deg. from the mill and 1,500 c.f.m. at 300 deg. from the boiler air heater, giving a resultant temperature of 141 deg., whereas the dew point was calculated to be 109 deg. The drop in

temperature to bring about precipitation is then 32 deg., or there is a 12-deg. margin over the anticipated drop of 20 deg. in the filters. It was thought this proportioning of the air would provide for sufficient mill drying. However, if operating experience proved that less heated air need be added because the temperature drop through the filters was less, then its amount was to be decreased.

As the equipment was to be installed in an existing building, there was not much choice as to its location; but it fitted conveniently into the mill cyclone room over the pulverized-coal bunkers and screw conveyors. The air is drawn off from the top of the cyclone return-air line to the mill by an exhauster fan through the five filter sections and discharged above the roof. The heated air is introduced under pressure in the duct between the cyclone and filters. The recovered coal is trapped in an air lock and deposited into the screw conveyors serving all the pulverized-coal bunkers.

The duct conveying the air to the filters is manifolded to distribute it evenly to each of the five sections operating in parallel. The discharge duct is similarly manifolded. Particular care was used in designing the manifolds to secure equal pressure drops in each section. The air enters at the bottom and is drawn off at the top, passing through the filters and leaving the coal particles adhering to the bags. To maintain unimpeded air flow across the fabric of the bags they are mechanically shaken at frequent intervals, the recovered coal dropping into a hopper and then into the air lock. During the shaking period the agitating mechanism automatically closes the dampers in the branches of each manifold against normal air flow and opens others for a reversal of flow to assist in the cleaning operation. The timing mechanism for shaking the bags is driven by a small electric motor and can be set to operate on any predetermined cycle. The power for shaking is furnished by compressed air under control of a timer. Only one section is shaken at a time, each section in turn until all are cleaned. This operation requires two or three minutes several times an hour.

Operating results confirmed the assumptions of the designing engineers as to permissible filter rates. The air discharged at all times, except during the shaking periods, was clean and free of coal dust. When the filters were shaken, however, there was evidence that all the coal was not being recovered. Analyzing the situation revealed that, with one section out of service during the 20 sec. or so for cleaning, the filter rate increased to over 7½ c.f.m. per square foot for the remaining four sections. It was then assumed that if six sections were used, five of which would always be in service, practically all the coal would be recovered, even during the shaking periods. The filter rate would then be 5 c.f.m. Upon this basis a sixth section was added and the correctness of the assumption proved.

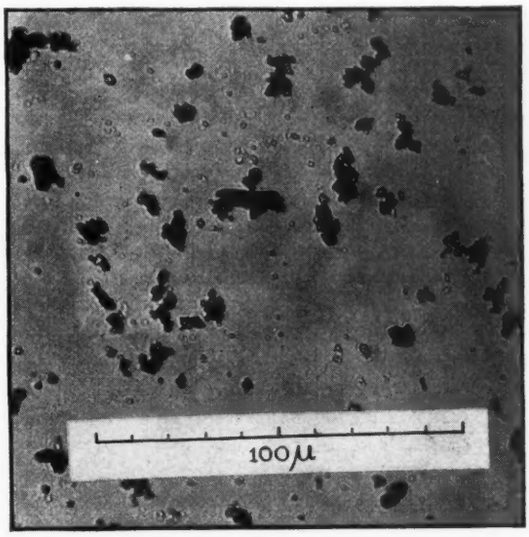
Being an initial installation upon which to base future procedure, it was desired to establish definitely the optimum filter rate that might be used for the reclamation of very fine coal dust. Engineering of this order predominated throughout the design of the Toronto station; not a dollar was invested in equipment that did not earn its own fixed charges by a considerable margin. By experimentation with these filters the data for an economical design were established. Recently a test was run to determine exactly what was being accomplished.

A total of 7,500 c.f.m. of air was cleaned at 136 deg., the resultant of 6,550 c.f.m. from the mill system at 119 deg. and 950 c.f.m. of heated air at 239 deg. The amount of air vented from the mill system, while less than originally contemplated, was sufficient to accomplish the coal drying desired. About 2½ per cent moisture was removed, or nearly 60 per cent of that in the coal fed to the mill. If, however, the coal should contain more moisture in the future than obtained during the test and it should become necessary to increase the heated air supplied to the mill, the filter equipment can take care of this increase up to a total of 10,000 c.f.m. and still give 98 to 99 per cent coal recovery from the vented air.

The observed temperatures are given in the table.

	Deg. F.
Return air from cyclone to mill	119
Heated air to mill	278
Resultant temperature of air to mill	143
Temperature of coal and air in cyclone	119
Heated air to filter inlet duct	239
Resultant temperature of air to filters	136
Air after passing through filters	123
Dew point of air in filters	85
Temperature drop through filters	13
Margin of safety over dew point	38
Clean air discharged to atmosphere	119
Air pressure drop through filters, in water	5.42

The coal reclaimed by the filtering process was 228 lb. per hour while the coal delivered to the mill was 25,300 pounds per hour; hence, almost 1 per cent was recovered. It was worth 24.5c. But it required some electrical energy to effect this saving. It cost 1.32c., or about 5½ per cent of the coal value. Of course the remaining 94½ per cent is not all saved, because out of it must be taken the fixed charges on the equipment. Their amount depends entirely on the hours of use per year. However, there is another credit item that is tangible but difficult to evaluate. It is the increase in combustion efficiency attributable to the greater percentage of impalpables in the coal fired, for over 99 per cent of that collected during the test passed through 300 mesh. Certainly all of the coal recovered is available for firing, which was not the case when the mill system vent air was returned through the primary air system. And the cost of reclamation is much less than the value of the fuel saved.



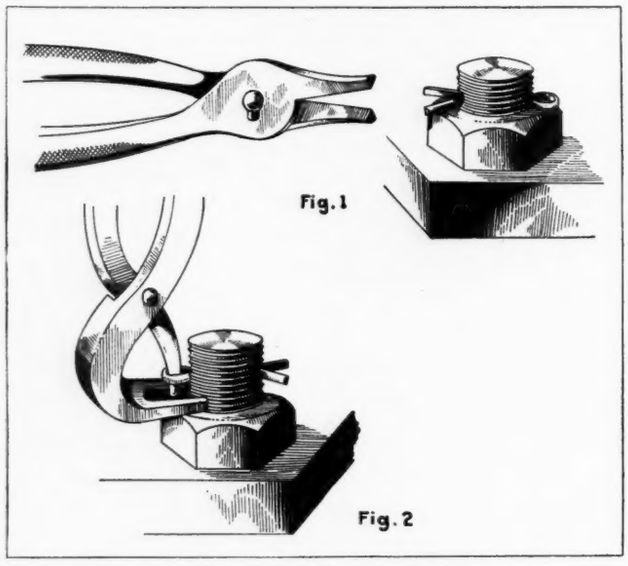
Microphotograph of coal particles of 300 mesh and smaller recovered by the equipment

It is comparatively simple to eliminate the conditions likely to lead to a fire hazard in the filter equipment. The bags are thoroughly dried by passing clean heated air through them for 15 min. before and after placing them in service each time, for the equipment is not operated continuously. The coal hoppers, chutes and air locks are kept clear, so there is no abnormal accumulation of fine coal dust to promote spontaneous combustion. Finally, but very important, is the cessation of a nuisance.

. . . RIGHT OUT OF THE PLANT . . .

Practical Tools for the Maintenance Crew

THE accompanying illustration shows two tools that were primarily designed for facilitating the task of putting in and taking out cotter pins. The tool shown in Fig. 1 was made by simply grinding the two jaws of a



Tools for spreading and removing cotter pins

regular pair of pliers wedge shape, as shown. These are handy in spreading the tongues of a cotter pin, and are often the means of saving skinned knuckles that occur frequently trying to spread cotters with a screw driver.

The specially shaped tool shown in Fig. 2 is easy to forge and will be found excellent for extracting a cotter without drawing it out of shape, so that it can be used again. These two tools will also be found useful for many other odd jobs about the plant.

Concord, N. H. C. H. WILLEY.

Keep the Engine Foundation Free of Oil

THE DETERIORATING effect of oil on concrete foundations is probably little appreciated by the average engineer operating a diesel engine station.

In a plant where I was employed a small single-cylinder engine broke the foundation one night, so that operation of the engine was discontinued because of bad vibration. There were also two other engines in the plant, one a single-cylinder and the other a four-cylinder unit. The two single-cylinder engines were of the older type, and around their foundation there was usually a puddle of oil.

When the plant was finally discontinued and the engines taken out, the foundations were broken up. It was found that the cause of the foundation deteriorating was nothing more than the oil that had gradually soaked into it. Down inside of the two single-cylinder engine foundations pockets of oil were found.

The engine that broke the foundation had been out of service for two years before the foundation was removed, yet there were cavities in it that still retained oil.

The foundation of the four-cylinder engine was in good shape, because the engine bed had a trough around it and no oil got on to the concrete.

For engines of the older type I recommend keeping the foundations well painted. I also recommend the use of a high-grade filler before the paint is applied. After the painting is done and the engine is in operation the oil should be kept wiped up or sawdust used to absorb the oil and help keep it from going into the concrete. ART WILLIAMSON.

Kimball, S. D.

Heat, Light and Power Costs in Hotels

AFTER studying Mr. Romine's "Heat, Light and Power Costs in Hotels" in the Feb. 17 number, I agree absolutely with your editorial which states, "The matter is certainly worthy of further investigation, but such general conclusions are dangerous."

The author states, "The cubical contents of the respective hotels were not available, however, and therefore the 'per-room' basis was the only measuring stick that could be used. In general, these hotels are much alike; consequently, it is thought that, for all practical purposes, these comparisons are fair."

To set up this statement as a basis is, in my judgment, all wrong. How could he possibly compare a 150-room hotel with a 600-room hotel, when it is apparent that the small hotel would be confined entirely to the entertainment of its own guests, whereas the larger hotel would also cater to outside or public functions that would produce an income independent of the rooms and at the same time would consume a substantial proportion of the light, heat and power used.

For hotel No. 1 there is given neither the electrical consumption nor the charges for same, but I assume the total cost includes the New York Edison bill; while hotel No. 14 produces 950,000 kw.-hr. annually and the total cost is included. The exhaust steam from the latter is

available for heating the building without any additional charge for coal.

Hotel No. 1 buys the small amount of ice it requires, whereas No. 14 has an ice plant making 300 tons per year, which, as well as running a cold-water circulating system, is also included in the operating cost.

It will also be noted that it costs hotel No. 1 $300 for removing ashes and rubbish and hotel No. 14 pays $395 a year for this.

I don't know why I should use such a basis of comparison, but based upon the tons of coal bought, it costs hotel No. 1 75c a ton as against hotel No. 14's cost of 10½c. Therefore it costs hotel No. 1 seven times as much to remove the ashes and rubbish. My only suggestion is that the manager of hotel No. 1 should get in touch with the ash man used by No. 14.

It is clearly evident that hotel No. 1 had two distinct charges, light and heat, while in hotel No. 14, the heating of the building was a byproduct of the light and power requirements.

Looking over the wage schedule, it is really too bad that hotel No. 1 had to have a chief engineer at all; one can imagine what this grade of man would do to the power plant of hotel No. 14.

I cannot resist the temptation to say, "What a travesty has been made of a set of figures." The picture of an accountant trying to say how an engine room should be run is tragic, to say the least.

New York City. A. S. VINCENT, *Chief Engineer,* Federal Reserve Bank.

Fitting Old Pistons with New Packing Rings

WHEN the cylinders of reciprocating engines, steam pumps and air compressors have become scored and worn unevenly to the extent of needing reboring, a perfect job often requires that the old pistons be discarded and new ones adapted to the enlarged bore. Otherwise the pistons may have so much play that the packing rings cannot keep them tight. The wobbling tendency of a piston too small for the bore is much greater in vertical than in horizontal cylinders. Another requisite is that the rebored cylinder be given extra lubrication until the minute ridges left by the boring tool have been worn down. Neglect of this precaution may result in such damage to the cylinder wall and packing rings as to undo the benefit the reboring was intended to secure.

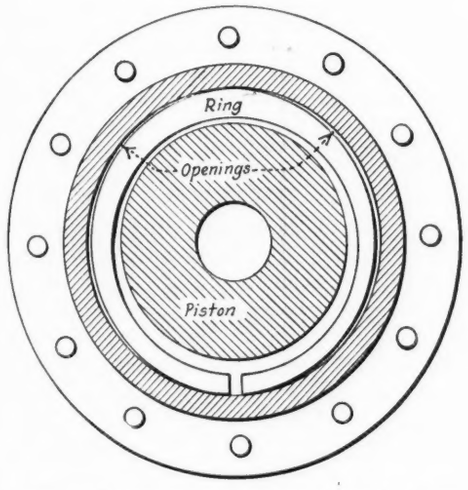


Fig. 1—Distortion of ill-adjusted packing ring

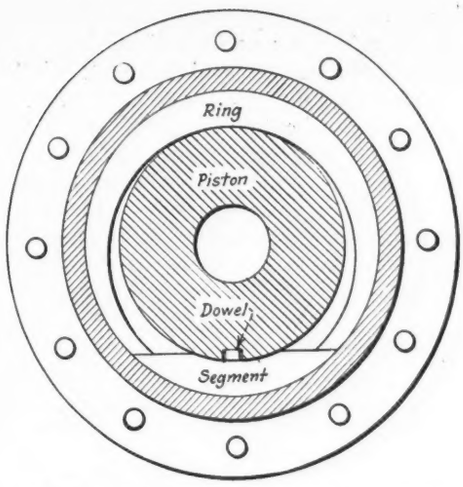


Fig. 2—Piston packing of straight-line engine

Where the reboring has not increased the diameter of the cylinder to the extent of necessitating a larger piston, it nevertheless is necessary in all cases to furnish the old piston with a new set of packing rings. It is not always good economy to apply for a new set of rings to the factory where the machine was built. Because of wear in the grooves of the old piston, the rings thus secured may fit so loosely as to be practically useless. Usually, the proper thing to do is to send the piston to the nearest repair shop equipped for such work.

First, it is necessary to put the piston and its rod between the centers of a lathe and true up the grooves. After this is done the rings may be made. A perfect job demands that the cylindrical blank from which the ring is cut shall be given an outside diameter considerably larger than the engine bore and an inside diameter somewhat smaller than that of the finished ring. Then, after a short segment has been sawed out of the ring, the opening thus made should be closed by springing the sawed ends together, the outside of the ring turned off to the exact diameter of the cylinder and the inside bored out to give the requisite thickness. Also, the sides of the ring should be faced off to a sliding fit in the grooves of the piston.

The inside and outside circles of snap rings for pistons of small and medium size should be turned eccentric to each other. A packing ring so formed will bear against the cylinder wall with an even pressure at all points in its circumference. But if this type of packing ring has been finished without first cutting a segment out of the thinnest section, springing the ends together, and then turning off the periphery to fit the cylinder, its liability to leak will be greater than that of a truly concentric ring. The sawed ends and the middle point or thick part of the ring will make hardest contact with the cylinder wall until abrasion has reduced the ring to a uniform bearing all around. Between these points the ring will have a tendency to stand away from the cylinder wall, as shown, somewhat exaggerated, in Fig. 1.

The construction in Fig. 2 represents an excellent form of snap-ring packing for the pistons of small and medium-sized horizontal engines. This style of piston packing was used on the straight-line engines designed by Prof. John E. Sweet. A cast-iron arc-shaped segment, turned off to the radius of the cylinder, is set stationary

in the lower part of the piston groove. This segment is just deep enough in its vertical dimension to block the piston up exactly central, and the ends of the eccentrically turned packing ring, abutted against the level surfaces of its lateral extensions, make steam-tight joints therewith. The necessary tension is given the ring, before snapping it on the piston, by springing the ends inward and turning off the periphery to the exact cylinder diameter. Packing rings so made have been found steam-tight after ten years of service. A. J. DIXON.

St. Louis, Mo.

Circulation of Water in Furnace Walls

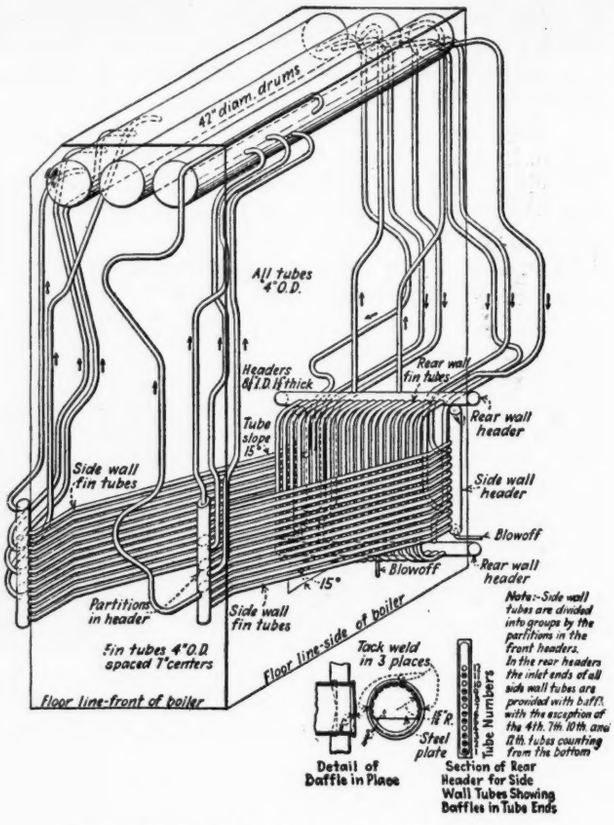
THE ARTICLE by William Welch, Jr., on "Water-Wall Experience at Interborough Station," which appeared some months ago, was undoubtedly of value to engineers interested in water-wall design. Reviewing briefly the important points outlined by Mr. Welch, before the final arrangement shown in Fig. 2 [reproduced herewith] was arrived at, 15 fin tubes had been employed at the side walls and were laid with a slope of 15 deg. Frequently occurring failures of the top side-wall tubes resulted in a thorough investigation of the water circulation conditions, by measuring the circulation speed by means of a spinner.

It was stated that the flow through the three upper tubes stopped temporarily, so that steam congestion and superheating occurred there, causing frequent burning out of the tubes. These three tubes were therefore removed, under the assumption that the cross-section of the riser pipe would then suffice for the discharge of the generated steam. The top tubes, however, continued to give trouble. The side-wall tubes were then divided into groups by partitions in the front headers. The top tubes of each group then tended to steam congestion and failures. In the bottom tubes of each group the free cross-sections at the inlet ends were closed up with baffles, which increased the resistance to the flow at this point to such an extent that the top tubes also received sufficient water. Since that time the boiler has apparently been working satisfactorily.

An explanation for these peculiar phenomena of steam congestion in the tubes at the top of each circulation system has not been attempted in the article. It is my opinion that this phenomenon may be traced to the following causes:

In a water wall composed of a multiplicity of superimposed water tubes, which, to start with, may be assumed to be horizontal, there prevails in each tube a higher water pressure compared with the tube located above it. If all tubes are equally heated, which will probably be the case in a furnace of the kind mentioned, steam will be first developed in the upper tube when the circulation is started, because the lower boiling temperature prevails there. This steam development does not at first increase the buoyancy, which promotes the circulation (as we have assumed horizontal tubes). On the contrary, the volume of steam generated in the tube displaces a corresponding volume of water, and thus increases the speed of the outflow. At the same time it reduces the inflow, which consequently turns toward the lower tube and there contributes to a reduction of the steam generated.

Thus is set up the contrasting behavior between the lower and the upper tubes, which may increase to such an extent that the inflow to the upper tubes ceases altogether or becomes reversed. Simultaneously with this increasing contrast grow the forces that effect an equalization. The steam forming the major content of the tubes finds a better opportunity to flow off due to its considerably lower volumetric weight than existed previously for the individual bubbles. The tube has thus again a better, perhaps even a normal, inflow imparted to it and the cycle can commence afresh. If the tubes are now given a slope, the differences in their behavior diminishes, since the steam bubbles tend to bring about a better supply of water, owing to the natural buoyancy now acting in the direction of the circulation.


42" diam. drums
All tubes 4" O.D.
Headers 6" I.D. ½" thick
Rear wall fin tubes
Rear wall header
Tube slope 15°
Side wall fin tubes
Side wall header
Blowoff
Blowoff
Rear wall header
15°
Partitions in header
Side wall fin tubes
Fin tubes 4" O.D. spaced 7" centers
Floor line-front of boiler
Floor line-side of boiler
Tack weld in 3 places
Steel plate
Tube Numbers
Detail of Baffle in Place
Section of Rear Header for Side Wall Tubes Showing Baffles in Tube Ends
Note:-Side wall tubes are divided into groups by the partitions in the front headers. In the rear headers the inlet ends of all side wall tubes are provided with baffles with the exception of the 4th, 7th, 10th and 12th tubes counting from the bottom

Isometric sketch showing water wall construction

This consideration leads to the conclusion that the slope of the tubes of 15 deg. in the case described is insufficient. It is common practice to place the tubes at an angle of 25 to 30 degrees.

The trouble could be overcome by the insertion of baffles into the lower tubes of each group, as these tubes tend to absorb the otherwise prevailing static pressure difference, which is the primary cause of the failures, in the form of a loss in flow. F. MICHEL.

Berlin, Germany.

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A COMPARISON of the results of the measurements on the slender power plant stack with those made on a relatively short experimental stack shows that the wind pressure on a chimney at a given wind speed increases as the ratio of the height to the diameter. In the case of chimneys having an exposed height which does not exceed ten times the diameter, it is safe to assume that at a wind speed of 100 miles per hour the wind pressure is not greater than 20 lb. per sq. ft. of projected area.—Department of Commerce, *Commercial Standards Monthly.*

Increased Power for Mercury-Arc Rectifiers

THE CURRENT-CARRYING capacity of mercury-arc rectifiers to change alternating to direct current can be increased almost without theoretical limit, it was announced by Dr. A. W. Hull, assistant director of the General Electric research laboratory, and H. D. Brown, engineer of the power rectifier department of the company, in a paper presented at the midwinter convention of the American Institute of Electrical Engineers, held in New York City at the end of January.

The secret of increased capacity for this type of equipment lies in using a large number of small anodes, or their equivalent, and narrow arc paths, instead of one large one in the rectifier. This is accomplished practically by combining the small anodes into a single large anode and subdividing the area below it with a multiplicity of small parallel arc paths.

Laboratory investigations of the characteristics of such divided anodes show that the current-carrying capacity is proportional to the total cross-section of the anode arm. If such a partitioning is not employed there is a limit to the amount of current that can be carried, irrespective of increase in size of the anode.

Experimental research during the last three years has removed much of the mystery that shrouded the mercury-arc rectifier, and has made it a piece of standard electric apparatus comparable to the motor and transformer. The effect of different factors upon the operation of the rectifier has been observed and the results interpreted in the light of theory. Much remains to be learned, especially in the field of high current and high voltage; but the boundary line between knowledge and ignorance is fairly well marked.

These investigations have greatly expanded the range of current and voltage that can be handled by a rectifier and have indicated the path for still further progress. No theoretical limit to either current or voltage is in sight at present.

The normal operating requirements of a rectifier are very simple: It must start easily, that is, it must begin rectifying whenever the alternating-current crest voltage exceeds the direct-current voltage by a small margin, of the order of 20 volts. It must not arc back, that is, allow current to pass in the reverse direction. The voltage drop between anode and cathode, when current is flowing, must be low enough to meet the efficiency requirements. The practical limits of voltage drop, approximately 20 volts minimum and 40 volts maximum, are generally satisfactory for line voltages of 500 or more, but are too high for 250-volt operation. The hot-cathode rectifier promises to fill this gap.

Voltage regulation will be required in the future; however, this is a circuit rather than a rectifier function in the case of a simple rectifier, and can be accomplished by transformer compounding. But grid-controlled rectifiers of the type called Thyratrons can be made to give any desired regulation without compounding.

The arc-back requirement has received most attention up to the present, because the greatest electrical sin of today is interruption of service. When a rectifier arcs back it is a two-way conductor instead of one-way, and hence constitutes a short circuit of the alternating-current supply line as well as the direct-current line or network that it feeds. The harm done by such short circuits, assuming they are cleared by circuit breakers, is mainly interruption of service. Rectifiers are built to withstand arc backs of less than one-second duration without injury, the only symptoms being a slight pitting of the anode tip, which has performed the forbidden function of acting as cathode, and a slight evolution of gas resulting from this melting.

The gas evolution accompanying arc back, if excessive, may delay resumption of service until the pumps can restore the necessary vacuum. Fast pumps and well-degassed anodes have reduced this time to the order of one minute, and experiments now in progress are expected to reduce it to one second or less.

Hot cathode rectifiers and Thyratrons are available in capacities up to 400 kw. at 8,000 volts. There are many features which make hot cathode rectifiers attractive, two of which deserve special mention. The first is ease of control of the mercury-vapor pressure. A second advantage of hot cathode rectifiers is low voltage drop, with resulting high efficiency at low operating voltage. The hot cathode rectifiers promise to fulfill the future requirements of low-voltage applications, with an efficiency of 95 per cent or better at 250 volts, and well over 90 per cent at 100 volts.

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NOTWITHSTANDING THE PROGRESS made in the efficient utilization of water power, petroleum, and other sources of energy, it seems reasonably certain, in most localities at least, that coal will remain the major source of steam and steam-electric power, according to H. M. Hoar, in a study of the world's coal industry just issued by the Department of Commerce. This prediction is based primarily on the steady improvement in technological processes of combustion and control which have taken place in recent years.

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Results of Boiler Tests Run At Midwest Power Exposition

RESULTS OF THE boiler tests run at the Fifth Midwest Engineering & Power Exposition, which was held recently in Chicago, are given in the accompanying tables. The tests were conducted by the Commercial Testing & Engineering Company on a Type C Kewanee boiler, rated at 70 hp., fired by a Model C Whiting stoker.

EVAPORATIVE TESTS

	Date of Test				
Kind of Coal	Feb. 10 Ill. 1½ In. Segs.	Feb. 11 Ill. 1¼ In.×¾ Segs.	Feb. 12 Ind. 1½ In. Segs.	Feb. 13 Ind. 1¼ In. Dustless	Feb. 14 Ill. Innergroup Segs.
Duration of test, hours	8.0	8.0	8.0	8.0	8.0
Feedwater temperature, deg F.	43.0	44.0	44.0	43.0	42.0
Flue gas temperature, deg. F.	500.0	519.0	568.0	588.0	532.0
Steam pressure, lbs. per sq. in.	6.0	6.0	6.0	6.0	6.0
CO_2, per cent	13.0	11.3	11.8	12.1	11.2
Equivalent water evaporated per lb. coal as fired, lb.	9.68	9.29	9.32	8.84	7.38
Efficiency of boiler, furnace and stoker	78.11	74.8	73.1	71.0	67.4
*Equating all tests back to 500 deg. F. flue gas temperature, efficiency per cent	78.11	76.7	76.1	73.7	71.4

PROXIMATE ANALYSES OF COAL (PER CENT)

Date Sampled	Feb. 10		Feb. 11		Feb. 12		Feb. 13		Feb. 14	
	As Fired	Dry Basis	As Fired	Dry Basis	As Fired	Dry Basis	As Fired	Dry Basis	As Fired	Dry Basis
Moisture	8.00	.....	8.32	.....	8.92	.....	9.57	.....	9.77	.....
Ash	9.32	10.13	8.52	9.29	6.81	7.48	7.25	8.02	15.81	17.52
Volatile	32.52	35.35	33.48	36.51	41.51	45.58	32.72	36.18	36.43	40.37
Fixed carbon	50.16	54.52	49.68	54.20	42.76	46.94	50.46	55.80	37.99	42.11
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
B.t.u.	12,025	13,070	12,054	13,148	12,373	13,585	12,079	13,357	10,629	11,780
Per cent sulphur	1.58	1.72	1.43	1.56	2.96	3.25	3.07	3.39	3.83	4.25

*The boiler was new and absolutely clean when the first test was run; therefore, it was only proper to figure the efficiency of all tests on the basis of the flue gas temperature obtained on the first test, Feb. 10, due to the boiler having accumulated soot and combustion dust during the remainder of the tests. It was impossible to blow down the soot and combustion dust, as there were no blowing connections made, due to the temporary hook-up for the week.

From Among Readers' Problems

Conducted by
L. H. MORRISON

SETTING CORLISS VALVES—*How does one go about setting the valves of a Corliss engine?* E.H.

A complete explanation of all the setting details is given in the booklet "Valve Setting," published by *Power*. Briefly, the first step is to see that the valves have the correct lap.

The wristplate should be unhooked from the reach rod and held fast in its central position by jamming the nut. To give the valve the proper lap, adjust the valve links to give the steam valves from $\frac{1}{8}$ to $\frac{5}{8}$ in., and the steam valves of single eccentric engines from $\frac{1}{16}$ to $\frac{1}{16}$ in., depending upon the size. Double-eccentric engines usually have negative lap, the valve being open a slight amount when the valve is in mid-position.

The links on the steam and exhaust valves are now adjusted in length to give the valves the amount of lap desired.

Having set the valves in this manner, with the wristplate in the center position, place the engine crank on either dead center and hook up the wristplate to the reach rod. Now set the eccentric enough ahead of its midposition to give the steam valve the amount of lead desired. Turn the engine over to the other dead center and see how much lead this steam valve has. In all probability it will not be exactly the same, but the error, if slight, may be corrected by changing the steam link length a small amount. This will, of course, change the lap, but not enough to make any material difference in the operation of the engine.

The governor regulates the point of cutoff of the engine. To adjust the points of cutoff, turn the engine to head-end dead center lay off on the crosshead guide a distance from dead-center mark equal to that portion of the stroke completed when cutoff is desired to occur. Say the engine is carrying a load requiring about one-quarter cutoff, then lay off one-quarter of the piston stroke. Lay off from the crank-end dead-center line an equal distance. With the crank at head-end dead center, block the governor to its highest position and, unhooking the hook rod, rock the wristplate back and forth. Adjust the governor cam rods until the knock-off cams just prevent the latch from engaging the latch block and so opening the valves, when the wristplate is thrown to the extremes of its travel.

This being done, hook up the hook rod and allow the governor to fall to its lowest position with the starting block in place. Turn the engine over until the crosshead reaches the head-end cutoff mark on the guide. Slowly raise the governor until the knock-off cam disengages the latch from the latch block, allowing the head-end steam valve to close. Block the governor in this position and turn the engine over past crank-end dead center until the crank-end cutoff position is reached. The crank steam valve should now be closed by the cam disengaging the latch. If not adjust the governor cam-rod. To check, unhook the wristplate and, with the governor block to the top, see if the latches engage when the wristplate is oscillated. If one of them does, no adjustment need be made if the cam promptly closes the valve before the valve opens more than $\frac{1}{16}$ to $\frac{1}{8}$ in.

In setting the safety cams, allow the starting block to fall out of place, permitting the governor to drop to its lowest position. The safety cam should now be far enough under the latch to prevent its picking up the latch block.

—◆—

COLOR OF EFFICIENT OIL FLAME—*In a heating boiler burning oil does an orange-colored flame indicate a better efficiency than a blue flame?* A.C.R.

In spite of a general idea to the contrary, combustion giving an orange flame is no more efficient than a blue flame.

PREVIOUS QUESTION DISCUSSED BY READERS

THE QUESTION

IN CONNECTION with a 3,000-kw. turbine we have a condenser with two horizontal banks of tubes without steam lanes. With cooling-water inlet temperature of 42 deg. F. and air leakage of 4 cu.ft. per minute the performance is as follows: When handling 8,000 lb. of steam per hour, absolute pressure 0.85 in Hg., exhaust temperature 74 deg. F., condensate temperature 49 deg. F. and cooling water outlet 48 deg.; when handling 35,000 lb. steam per hour, absolute pressure 1.35 in. Hg., exhaust temperature 90 deg., condensate temperature 64 deg., and cooling-water outlet 62 degrees.

Would it be possible to form steam lanes deep into the tube bank? R.V.G.

▼

DO NOT cut tubes out of the condenser to form steam lanes—it would defeat the purpose of the original designers. Instead of the hot steam striking the warmest tubes first, and cooling as it passes downward, as is the case at present, the steam would be led down through the channels made by removing the tubes, reaching the coolest water first.

The trouble seems to be the air pump. If the air leaks around the turbine center flange or expansion joint, the leakage should decrease as the load increases.

The terminal difference is 28 deg., when it should be 8 deg. F. The condenser is using 1,820,000 lb. of water per hour, whereas it should not exceed 1,050,000 lb., and 910,000 lb. would be enough. The correct temperature of the discharge water should be 82 deg. F.

Fill the turbine and condenser full of water under 15 lb. pressure, to show all air leaks, blank the air line to the air pump, and drill a hole in the air line and attach a mercury column. Then start the air pump and see if it draws a vacuum of 29.732 in., or 29.153 if the machine is a dry air pump.

The vacuum can never be better than that created in an air-tight chamber by the air pump. The conditions are ideal for condensing, and with a clean condenser, no air leaks and a good working pump, fine results should be obtained. But remember it will do no good to maintain an absolute pressure of 1 in.

Hg. if the turbine was designed for 2 in. Hg.

For example, if the turbine was designed for 2 in. Hg. at 35,000 lb. steam per hour, the last row of blading is spaced to pass 12,278,000 cu.ft. of steam per hour. If 1 in. Hg. abs. is carried it will have to pass 26,390,000 cu.ft. per hour. So what would be gained in velocity by the higher vacuum is lost by the steam at that pressure and volume not being able to pass the blading. There will be no increase of efficiency if 1 in. Hg. is carried instead of 2 in. Hg. in a turbine designed for 2 in. Hg. abs., but if it was designed for 1 in. abs., a drop from 1 to 2 in. Hg. would create a loss in efficiency of about 7 per cent.

Detroit, Mich. LEONARD LONG.

THERE appears to be some irregularity in the operation of this condenser, as the condensate is cooled 26 deg. at full load, whereas 10 or 12 deg. undercooling is usual with old types of condensers. Modern designs deliver their condensate at about exhaust steam temperature.

The air leakage is normal. It may be that a water level is carried in the condenser which allows drowning of the lower tubes, with a consequent loss of heat to the circulating water.

Should this be the case, and other remedies are inconvenient, the offending tubes should be removed and the holes in the tube plates blanked with brass disks under the ferrules, made tight with suitable jointing.

If it is desired to experiment further, an improved efficiency might be obtained by removing tubes down to the side of the bank opposite the air suction. This will give the steam a much greater entrance area to the tube bank and at the same time put steam in contact with the condensate, thereby keeping it up to full exhaust temperature.

Due consideration should be given to the location of the air suction baffles and other features in connection with any such alteration. E. C. HARRIS.

Hornchurch, Essex, England.

THE FIRST thing to do in this case is to communicate with the manufacturer of this condenser, as he has data and results from tests which would be impossible for the purchaser to attempt.

The given values as applied to an up-to-date condenser with steam lanes may be followed through as shown below. This determines the condensing surface required. If your condenser does not have at least 5 per cent over this amount, it would not be advisable to cut down on the number of tubes.

Steam lanes are improvements in condenser design. As the steam passes down through the tubes it decreases greatly in volume, allowing closer tube spacing with no increase in friction.

A careful examination may prove it unnecessary to cut out any tubes. The tubes should be inspected and cleaned, if necessary, both inside and out. The amount of cooling water and velocity should be checked up. It is stated that there is an air leakage of 4 cu.ft. per minute. This should be corrected before attempting to change the condenser design.

The calculation of the condensing surface with steam lanes follows:

$$\text{Sq.ft.} = S = \frac{950W}{Ut}$$, where W is the lb. of steam per hour, U the coefficient of heat transfer and $t = t_3 - \frac{t_1 + t_2}{2}$ when t_3 is the exhaust temperature, t_1 is the inlet-water temperature and t_2 is the discharge water temperature. With the given data $t = 90 - \frac{42 + 62}{2} = 38$ deg. Assuming a value of 400 for U, which will be correct for 1-in. tubes with a 6 ft. per second water flow, for $\frac{3}{4}$-in. tubes with a 5-ft. per second and for $\frac{5}{8}$-in. tubes with a 4.5 ft. per second flow, the condenser surface will be $S = \frac{950 \times 35{,}000}{400 \times 38} = 2{,}187$ sq.ft. The surface per tube will be $\frac{3.142d}{12} \times L$ in sq.ft., where d is the diameter in inches and L the tube length in feet. This result divided into 2,187 will give the number of tubes. As stated before, if the condenser does not have this amount it is inadvisable to remove any tubes without first consulting the manufacturer.

The best arrangement would be to remove four tubes in the top row and the same for several rows directly below. Then remove three for several rows, then two, and then one, resulting in a V-shaped passage. This may be done in several places at equal distances along the width of the tube sheet. The number of tubes that may be removed, as determined by the above computations, will decide the best arrangement of these lanes. H. M. SPRING.

Milford, N. J.

WITHOUT knowing the square footage of surface, the amount of water circulated and the size and length of tubes, it is not possible to check the vacuum with any great degree of accuracy. By making certain deductions, however, it seems probable that the limit is a 3,500-sq.ft., two-pass, down-flow surface condenser with $\frac{3}{4}$-in. diameter, 16-ft. tubes, circulating 3,000 g.p.m. of 42-deg. F. water. When condensing 8,000 lb. of steam, it is not probable that a vacuum higher than 29½ in. Hg. can be obtained, and when condensing 35,000 lb. of steam 28.85 in. Hg., which figures are based on 85 per cent clean tubes and the vacuum referred to 30 in. of mercury. If the size of this condenser agrees with the one in the question, the performance obtained in regard to vacuum is about right.

The small difference in temperature between the condensate and the cooling water indicates that the lower portion of the tubes are submerged in the condensate. This condition can be corrected by installing a larger hotwell to drain the condensate from the condenser shell, and by providing a steam lane to allow the steam to pass over the condensate as it drips from the tubes. Such a steam lane should be located on the side opposite the air offtake, by removing the tubes next to the shell to form a cresent tapering toward the bottom of the condenser. The inertia will carry the steam across the path of the dripping condensate, thereby making the condensate temperature more nearly equal to the steam temperature.

To plug the tube plates should present no difficulty. If the tubes are packed at the ends, a screw plug will be the most convenient to use, but if the tubes are rolled in, a short piece of tubing closed on one end can be rolled in.

Metuchen, N. J. V. FAILMEZGER.

A Question for Our Readers

IN OUR PLANT the incoming 2,300-volt, alternating-current line has a branch leading to a transformer and from there to a rotary converter. Another branch goes to a 500-hp. synchronous motor driving two air compressors. When either one of the compressors runs idle, that is, with the motor operating at one-half load, the pointers on the alternating-current and the direct-current switchboard meters oscillate. The number of oscillations seems to be the same as the number of revolutions of the motor and compressors. When both compressors are working the meters are steady, which is also the case when both compressors are running idle. Suggestions as to the cause and remedy would be appreciated. A.L.

Suitable answers from readers will be paid for[1] and published in the April 14 number

[1]As an alternative to cash payment for answers published, readers may select any one of the following books. (Be sure to state the book desired.)

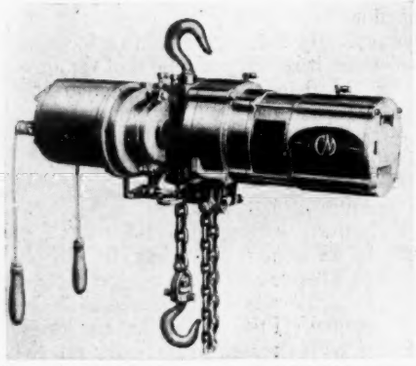
Morrison's *American Diesel Engines*; Walker and Crocker's *Piping Handbook*; Norris and Therkeisen's *Heat Power*; Emswiler's *Thermodynamics*; Church's *Steam Turbines*; Uehling's *Heat Loss Analysis*; Croft's *Steam Power Plant Auxiliaries and Accessories*; Powell's *Boiler Feed Water Purification*; Osborne's *Power Plant Lubrication*; Moyer and Fitz' *Refrigeration*; Rietschel-Brabbee's *Heating and Ventilation*; Annett's *Electric Elevators*.

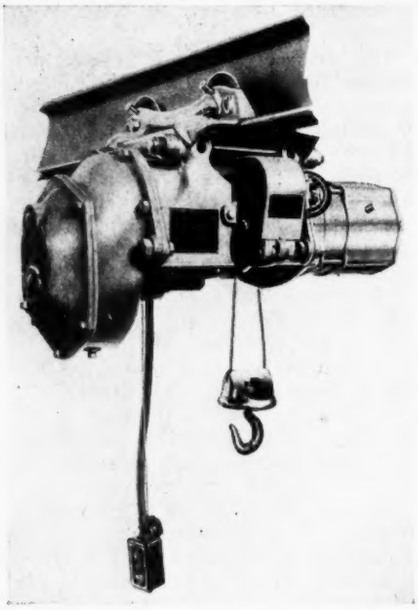
WHAT'S NEW IN PLANT EQUIPMENT

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING, TRANSMITTING AND APPLYING THE POWER SERVICES

Chain and Wire Rope Hoist for Low Headroom

THE ILLUSTRATION shows the "Cyclone" electric chain hoist and the "Hi-Up" electric wire rope hoist recently introduced by the Chisholm-Moore Hoist Corporation, Tonowanda, N. Y. Both hoists are designed for use where headroom is limited.





"Cyclone" ball-bearing chain hoist and "Hi-Up" wire rope hoist

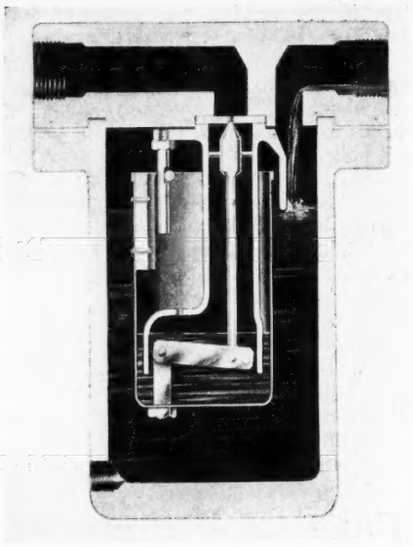
The chain hoist is fitted throughout with ball bearings and is driven by a ball bearing motor equipped with a built-in magnetic brake. The use of a magnetic brake in addition to the usual shoe-type mechanical brake is said to provide accurate control of the load in hoisting or lowering and to prevent drifting. The hoist is normally furnished with hook suspension, but where desired it can be furnished closely connected to a low headroom type of tandem trolley. It is supplied with either pendant rope control or push-button control.

In the wire rope hoist shown in the lower view the $\frac{1}{4}$-ton capacity unit requires only 13 in. headroom, and the 1-ton capacity requires only 15 in. of headroom. The hoisting mechanism is equipped with roller bearings and the driving mechanism with ball bearings. The motor is similar to that used on the chain hoist previously described. The hoist can be furnished with lug suspension for stationary mounting or equipped with ball bearing push-type trolley. Push-button control is standard.

Forged-Steel Trap for High Pressures

THE OPERATING principle of the new steam trap for high pressure put out by the Wright-Austin Company, 2231 Park Ave., Detroit, Mich., is identical with that used in the "Airxpel" trap for pressures up to 250 lb., introduced about three years ago by this company. The body and cover of the new trap are of forged steel built for operating pressures up to 700 lb.

A tongue-and-groove joint with metallic gasket is used between the body and cover, the latter being secured by chrome-steel bolts. The valve and seat are of nitralloy, heat-treated and nitrided. The bucket is of chrome-plated copper, and the working parts are of chrome and stainless steel.

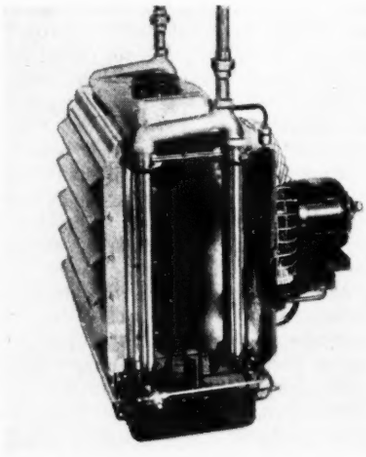


Airxpel forged-steel trap

This new trap, like the previous model, can be hung on the pipe line without other support, has straight-way horizontal connections, and the working parts are readily accessible without disconnecting the trap from the pipe line.

Unit Gas Air Heater

EITHER manufactured or natural gas can be burned in the Humphrey No. 200 unit gas heater put out by the General Gas Light Company, Kalamazoo, Mich. It has an input rating of 200,000 B.t.u. per hour. When equipped with a six-blade fan, propelled by a $\frac{1}{4}$-hp.,



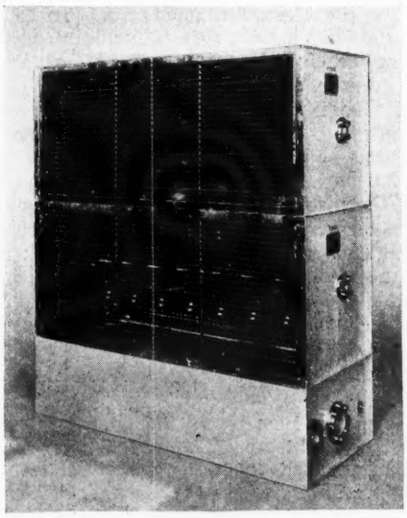
Humphrey No. 200 unit heater

1,140-r.p.m. motor, the unit will deliver 2,600 cu.ft. of air a minute with a 50-deg. temperature rise over room temperature. It is said to be 83 per cent efficient when vented and is equivalent to about 700 sq.ft. of steam radiation.

Over-all dimensions are, 32¼ in. high, 28¼ in. wide and 31¼ in. deep. The unit may be operated by either remote or thermostatic control.

Compact Air-Conditioning Unit

OCCUPYING about half the space required for the standard type of air washer of the same capacity, the Filticooler, brought out by the B. F. Sturtevant Company, Hyde Park, Boston, Mass., is designed to



Sturtevant Filticooler for washing, filtering and cooling air

filter, wash, cool and humidify the air passing through it.

It is made in fifteen sizes, and is available in units of one, two or three sections, as required, each section being 29 in. high and 28 in. deep in direction of air flow. Widths vary from 20½ in. for No. 1 size to 10 ft. 8½ in. for No. 10. Each unit consists, essentially, of two eliminators, two air filters, and a set of spray nozzles. The air filters are continually flushed by water, which prevents their clogging up and reducing the air flow. To permit of placing the air fan close up to form a compact unit the eliminators are divided in the middle and face both ways.

The various types of automatic controlling devices used on other types of washers may be adapted to the Filticooler.

Heavy Welding Electrode

A HEAVILY coated electrode, designated Type R, is announced by General Electric Company, Schenectady, N. Y. It is composed of 0.13 to 0.18 carbon steel covered with a heavy coating of cotton braid impregnated with an arc-stabilizing flux. The electrode is available in diameters from ⅛ to ⅜ in. x 18 in. length.

Metal deposits of this electrode are said to have high tensile strength and to produce a homogeneous structure resulting in a ductile weld. This is caused by the fact that, during the arc-transference period, the metal is in a protective atmosphere, because the electrode itself burns away more quickly than the coating, and excludes the air.

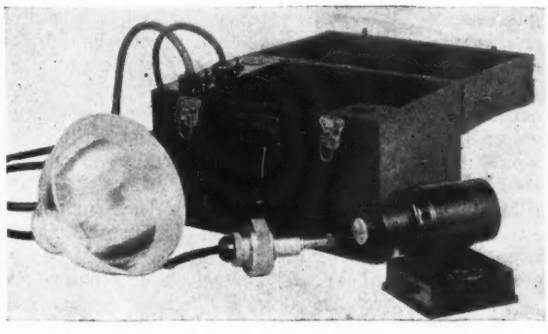
Improved Vibroscope With Increased Illumination

WITH approximately five times the illuminating power of the Model 1 Vibroscope, which has been available for a number of years, the Model 3 instrument recenty brought out by the Electrocon Corporation, 6 Varick St., New York City, is applicable to the study of any type of motion that occurs in repeated cycles on apparatus running at speeds from 40 to 12,000 revolutions per minute.

The instrument operates on the well-known stroboscopic principle, depending upon the interruption of vision between the operator's eye and the mechanism under observation, so that he gets a quick glimpse of the mechanism each time it reaches a certain point in its cycle. This quick succession of glimpses at the same point each time causes the mechanism to appear stationary at that point.

A hand lamp consisting of an aluminum reflector 8½ in. in diameter and three Neon tubes is used to illuminate the moving mechanism. The lamp is made to flash in synchronism with the motion or at a low multiple of it by means of a breaker head driven from the mechanism under observation in a manner similar to a hand tachometer. In the breaker head the electrical circuit is broken once per revolution at a pair of cam-operated platinum points. By adjustment of a small knurled knob in the breaker head the Neon tubes can be made to flash at different positions in the revolution, so that the moving mechanism may be observed at different points in its cycle. For speeds above 12,000 r.p.m. the small motor unit shown in the illustration is used. The motor unit is run at a low multiple of the speed of the equipment under test.

The Vibroscope forms a part of the Davey portable balancing equipment and is furnished wired for the Davey vibrometer, which must be added for balancing purposes.



Model 3 Vibroscope with motor unit for high speeds

J.M. No. 350 semi-metallic packing

Square Semi-Metallic Packing

AVAILABLE in coil and ring form, in sizes ¼ in. and up, J.M. No. 350 semi-metallic packing, put out by the Johns-Manville Corporation, 292 Madison Ave., New York, N. Y., is suitable for use on steam, air, water, oil, etc., on rotating rods at high pressures and temperatures up to 500 deg. F.

The packing is plaited up square from a combination of asbestos fiber and non-abrasive metal, the whole being thoroughly lubricated and graphited. The packing can also be used on reciprocating rods and plungers either alone or in combination with other packing. A modified packing, No. 351, semi-metallic, is designed for use with gasoline and cold mineral oils.

NEWS of the FIELD

Senate's Failure to Override President's Veto Kills Muscle Shoals Legislation

White House message assails federal government operation plan and suggests control by interested states

BRANDING IT as economically unsound and a threat to the initiative of private enterprise, President Hoover vetoed the Muscle Shoals bill on March 3. The Senate sustained his veto by the narrow margin of 34 to 49, only a few votes short of the two-thirds necessary to pass the legislation over the objections of the President.

In his veto message, Mr. Hoover attacked the program provided for in the measure on two grounds, its economic impracticability and its un-American principle of government operation in competition with private business. Proposing an alternate plan for the operation of the Shoals plants, he suggested that Alabama and Tennessee, the states most directly affected, undertake to lease and operate the nitrate and power plants through a commission composed of state leaders, representatives of national farm organizations, and army engineers.

Such a program, the President said, would serve both the local communities and agriculture generally. The lower plants at present, he said, are making a small margin of profit. This margin should be increased under his proposed program, the President asserted and used "for the benefit of agriculture." The federal government, he said, should build the big Cove Creek Dam as a flood control measure, when such a lease has been made.

By means of a detailed analysis of operating costs, President Hoover showed how the government would lose $2,000,000 a year if it attempted to run the Shoals power plants in accordance with the provisions of the bill. He valued the present plant at $42,000,000 with an additional $90,000,000 required for alterations and transmission lines, which at 4 per cent interest would mean a yearly capital charge of $5,080,000; amortization was fixed at $1,890,000 a year; operating and maintenance costs of the hydro-electric installation, steam plant, and transmission lines were estimated at $2,175,000 a year—giving a total annual overhead and operating cost of $9,145,000. With a total net output of 1,000,000,000 kw-hr. annually, "the estimated cost of production and distribution is, therefore, about 9.1 mills per kilowatt-hour," he stated.

"Assuming that the whole 1,000,000,000 kw.-hr. should be sold to municipalities or other power distributers," he said, "it would on the basis of the realizations of the private companies of 7.2 mills, yield a gross annual income to this project of about $7,200,000, or a loss upon this basis of nearly $2,000,000 annually. This territory is now supplied with power and to obtain such an income it would be necessary to take the customers of the present power companies. To secure these customers it would be necessary to undercut the rates now made by them. It is difficult to estimate the extent to which it would be necessary to go in such rate cutting in order to secure the business. In any event it would of course diminish estimated income and increase the losses."

By a similar analysis of the fertilizer and nitrate plants, President Hoover reached the conclusion that private concerns were now producing synthetic nitrogen in sufficient quantities to cover any possible requirement for war, and, as far as fertilizer was concerned, that the problem was so great that "no chemical industry with its constantly changing technology and equipment, its intricate problems of sales and distribution, can be successfully conducted by the government."

Western Combine Submits Low Bid on Hoover Dam

A COMBINATION of Western construction firms—the Six Companies, Inc., of San Francisco—submitted the low bid March 4 for the general contract on the Hoover Dam and power plant and won a recommendation that their figure of $48,890,995.50 be accepted by Ray Lyman Wilbur, Secretary of the Interior.

The Six Companies, Inc., include the Utah Construction Company of San Francisco and Ogden; Henry J. Kaiser and W. A. Bethel & Company, San Francisco; McDonald & Kahn, Ltd., San Francisco; Morris, Knudsen & Company, Boise, Idaho; J. F. Shea Company, Portland, Ore.; the Pacific Bridge Company, Portland.

The bid of the Six Companies, Inc., was $5,002,883.20 lower than that of its closest competitor, the Arundel Corporation of Baltimore. Woods Brothers Corporation of Lincoln, Neb., the other competitor, bid $58,653,107.50.

Frank T. Crowe, of Boise, Idaho, will be general superintendent in charge of construction. He has had 26 years of practical experience in building dams for the Reclamation Service. In 1924 and 1925 he was general superintendent of the United States Reclamation Service here.

More than 1,000 workers will be taken to the dam area to begin operations, which are expected to start in 30 days. Full details of the Colorado River project, the largest engineering enterprise ever attempted in the United States, will be published next week in the leading article of *Power*.

Regulation of Interstate Power Urged in N. Y. Bill

UNDER THE PROVISIONS of a bill introduced March 3 in the New York State Senate by Majority Leader John Knight and in the assembly by Majority Leader Russell C. Dunmore, a temporary state commission is created to consist of six members—two to be appointed by the governor, two to be senators, and two to be members of the assembly—to act jointly with similar commissions of states adjoining New York, in making a survey of utility companies engaged in interstate transmission of power, to formulate the terms of a treaty between such states and the federal government and to recommend proposed legislation, state and federal, necessary to effectively regulate and control utility companies engaged in such interstate transmission of power. The sum of $10,000 is appropriated for the survey.

In introducing this measure, Senater Knight and Assemblyman Dunmore pointed out that with the growth of so-called holding companies and the formulation of great combinations and consolidations, the exportation of power from New York State and the importation from neighboring states is greatly increasing. The federal government has taken cognizance of this situation, they stated, and there is already pending

before the Senate a bill which, it is feared, would eventually lead to complete control by the federal government of the great companies distributing power in New York State. It is probable that in the near future no company will be engaged in the distribution of power entirely within New York State, and as a consequence all companies may become subject to the jurisdiction of the federal government as utilities engaged in interstate transmission.

First 1,400-Lb. Unit in Southwest Goes on Line

THE FIRST 1,400-LB. INSTALLATION to be completed in the Southwest was placed in service recently by the San Antonio Public Service Company at its old standby station "B" in San Antonio, Texas. The installation consists of a 1,400-lb. pressure boiler supplying a 7,600-kw. high-pressure turbine-generator. Fired by ten combined natural gas and mechanical-atomizing oil burners, the boiler has a capacity of 215,000 lb. of steam per hour. The turbine operates at 3,600 revolutions per minute.

The old plant has been completely remodeled to take care of the new unit, which operates in conjunction with the original installation. Exhaust from the new high-pressure turbine at 75 lb. is used to drive the older 12,000-kw. unit, thereby raising the capacity of the station to nearly 20,000 kilowatts.

Bill Creating New York Power Authority for Development of St. Lawrence Submitted

Governor Roosevelt and leaders of legislature receive majority act of St. Lawrence power development body

A PROPOSED STATUTE creating "The Power Authority of the State of New York," to develop hydro-electric power in the International Rapids section of the St. Lawrence River, was submitted March 2 by the four majority members of the St. Lawrence Power Development Commission to Governor Roosevelt and the majority leaders of the legislature. Drafted to carry out the recommendations submitted by the majority in its report Jan. 15, the bill provides for a body consisting of five trustees, modeled generally after the Port of New York Authority.

The project is described in the statute as one for the aid and improvement of hydro-electric power in the interests of the people of the state, to whom, it is provided, the natural resources in the St. Lawrence River shall always remain inalienable. The act authorizes the power authority to seek co-operation and agreement with the United States Government and the Canadian authorities, and to secure the necessary consent from the United States and Canada for the construction of the project.

In furtherance of this policy the power authority is directed to reserve a certain amount of the power generated for sale to municipalities throughout the state. Such sale may be made directly by the power authority or under agreement between the power authority and the private purchaser, who will undertake the resale of the power to the municipalities substantially at cost. The private purchaser may also be required to construct short connecting lines from its own system to such municipalities.

Before any work is undertaken by the power authority, beyond preliminary investigations and surveys, it is required to have entered into contracts with existing companies, or companies to be formed, for the sale, transmission, and distribution of the power on terms which will assure the effectuation of the policy declared in the act, and a revenue return sufficient to support the bonds of the power authority to be issued for the project. The contracts must require the purchaser to disclose all factors of cost to the power authority, so that rates to consumers may be fixed and changed from time to time in such way as to assure them the benefit of public ownership and operation of the generating plant and encourage a greater use of power. By means of such a contract, it is intended to escape from the technicalities of rate regulation under the Public Service Commission Law and to afford consumers the protection of contractual undertakings.

The power authority is given authority to issue its own bonds for the construction of the project, which is intended to be self-supporting. Such bonds will not be obligations of the state. No bonds may be issued until contracts have been made sufficient to assure revenue for the maintenance and operation of the project and the debt service.

Public hearings are required to be held on the terms of any proposed contract and they are then to be submitted for the approval or disapproval of the Governor before they can become binding.

If the power authority is unable to make satisfactory contracts, or if the Governor disapproves them, then it is directed to report a plan for the disposal of the power "through some other method or methods, which in its judgment will effectuate the policy and purposes of this act, including the building of transmission lines, steam plants, and (or) distributing systems by it, if it finds the same practicable, together with estimates of the cost of such additional facilities, and the revenues to be derived therefrom." Any such plan will require further legislative approval before construction of the project may be undertaken.

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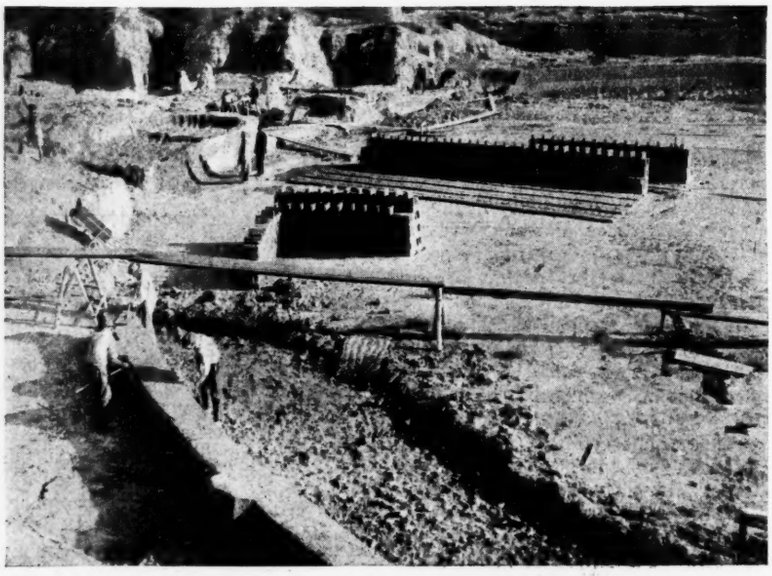
TO SAVE MILLION DOLLARS YEARLY

First coils being lowered into a vat of solventless varnish—the new impregnating material for electrical equipment developed by J. T. Goff of the Westinghouse Research Laboratories. Through the complete impregnation attained by treating coils, motor and generator windings, and similar pieces with solventless varnish, it is calculated that this new insulating compound will save the electrical industry over a million dollars a year, cutting production costs as well as maintenance charges

SUN POWER PLANT NEARS COMPLETION



The first power station in the Soviet Union to use the sun's rays directly as a source of energy is rapidly nearing completion in Samarkand, Turkestan. It is expected to be in operation this summer. Designed by M. Kosmind-Yushenko, Soviet helio-technical engineer, the plant will have a capacity of 210 hp. and will furnish heat, mechanical, and electrical energy on a semi-industrial scale. Some years ago a similar plant was built in this country near Philadelphia, Pa., with a capacity of approximately 150 horsepower

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Work Started on 100,000-Kw. Addition to Long Beach

SOUTHERN CALIFORNIA EDISON COMPANY, has awarded contract covering the design and construction of a 100,000-kw. addition to its Long Beach, Calif., steam station to Stone & Webster Engineering Corporation, according to George C. Ward, executive vice-president of the Edison company. The work covered by the contract amounts to approximately $7,500,000. It is expected that construction will be completed in 1932. Work on the condensing water intake and tunnels already is under way.

With the addition of the new unit, the third of this capacity to be installed in the Long Beach plant, the total station capacity will be increased to 515,000 kw. The new unit will be the twelfth installed since the station was begun in 1911. Two units of 100,000 kw. each were installed in the third section of the station on June 20, 1928, and Feb. 23, 1930, respectively. The new unit will be a duplicate in all major respects of the last two installed.

First Year's Operation Of Perak Hydro Reported

THE FIRST YEAR of commercial operations of the Perak hydro-electric project in British Malaya was one of considerable disappointment, it was brought out at the recent annual meeting of stockholders in London. Though an immense construction program was brought to practical completion and operation of the plant begun during the year, expected contracts for the entire load capacity of 45,000 kw. had not been secured due to the curtailment of tin mining operations as a result of the unexpected drop in the price of tin. It was generally felt, however, that conditions would be better during the coming year, and that given a return of prosperity to the tin industry, there would be ample demand to load up fully the present capacity of the system.

The project comprises a 1,000-ft. dam and power house with an installed capacity of 27,000 kw. In addition there is a steam station containing three 6,000-kw. turbine-generators. The Federated Malay States Government holds a large financial interest in the development and exercises supervisory control over it.

A. S. M. E. Reports Progress On Pressure Piping Code

A CHAPTER dealing with the fabrication details of hangers, supports, anchors, sway bracing and vibration dampeners has been completed recently by the subcommittee on fabrication details of the A.S.M.E. Sectional Committee on the Code of Pressure Piping. The section on fabrication, of which this chapter forms a part, will include, in addition, fabrication details for joints other than welded, pipe bends, power piping and a chapter on welding. The entire Code for Pressure Piping, when completed, will contain sections on power piping hydraulic piping, gas and air piping, refrigerating piping, oil piping, piping materials and identifications, and fabrication details.

Copies of the chapter on fabrication details of hangers have been widely distributed to industry for criticism and comment, and as this release is in tentative form, the committee will welcome any comments. Additional copies are now available for review and may be obtained by addressing a request to C. B. LePage, assistant secretary, A.S.M.E., 29 West 39th St., New York City.

Benson Generator Used For Ship Propulsion

EXPERIMENTS are now being conducted jointly by the Hamburg-American Line and the shipbuilding firm of Blohm & Voss, Hamburg, Germany, on the application of the Benson steam generator to propulsion of the steamer *Uckermark*, according to a report in the Feb. 11 issue of the *VDI Nachrichten*. This is the first time a Benson boiler, erected by a shipbuilding company, has been installed in a marine power plant. Generating steam at 3,200 lb. pressure and 850 deg. F. temperature, the boiler supplies the propelling turbines and auxiliaries at a reduced pressure.

"The adaptation of the Benson steam generator developed by the Siemens-Schuckertwerke for stationary power plants to the conditions on board ship and the particular operation of the main engines and the auxiliaries, which is required by the new method of steam generation, was successful during several trial runs," it is stated in the report. "All necessary manoeuvers and changes in power output were accomplished quickly and reliably. On a voyage to Dutch India, the whole power plant worked without interruption and yielded a favorable fuel consumption."

Ralph Modjeski Receives Washington Award for 1931

AT A DINNER given in his honor at the Palmer House, Chicago, on Feb. 25, Ralph Modjeski, the famous bridge engineer, received the Washington Award for 1931. This honor was bestowed by the Washington Award Commission, representing the four founder societies and the Western Society of Engineers, for the recipient's "contribution to transportation through superior skill and courage in bridge design and construction."

Starting in Chicago as a draftsman associated with some of the pioneer engineers of the Middle West, Dr. Modjeski soon displayed remarkable ability and embarked upon a consulting career. His ability has been recognized by such

honors as the John Fritz Medal, the Franklin Medal, the French Legion of Honor and two honorary degrees of doctor of engineering. Dr. Modjeski is a past president and honorary member of the Western Society of Engineers.

Guest speaker of the evening was Ralph Budd, president of the Great Northern Railway Company, and E. T. Howson functioned as toastmaster. The presentation of the award was made by W. O. Kurtz, president of the Western Society of Engineers. A program of classical music by the mixed chorus of the Universal Atlas Cement Company entertained the diners. The attendance approximated 400.

A.S.M.E. Meeting at Birmingham, April 20-30

TENTATIVE PROGRAM has just been announced for the semi-annual meeting of the American Society of Mechanical Engineers, to be held at the Tutwiler Hotel in Birmingham, Ala., from April 20 to 23. Ten technical sessions will be held during the four days, interspersed with interesting inspection trips and entertainments. An important feature of the meeting will be an all-day trip through spectacular scenery to the Martin Dam plant of the Alabama Power Company.

Among the papers to be presented at the technical sessions, the following are of particular interest to power engineers: "The Application of Hydraulic Laboratory Researches to the Problem of Hydro-Electric Utilities," by I. A. Winter; "Present Status of Hydro-Electric Development in the Southeastern United States," by W. P. Hammond; "Calibration of a Large Nozzle," by J. R. DuPriest and J. H. Polhemus; "Design Considerations of a Natural Gas Transmission System," by C. W. Merriam; "Heat Transfer From Condensing Steam to Flowing Water Through Single Metal Tubes Surrounded by Air-Free Steam," by A. T. Brown; and "Design Features and Operating Results of the Fairfield Blast Furnace Power Plant," by Frank G. Cutler.

Samuel Insull Honored at 50th Anniversary Banquet

MEMORIES of a young English boy with an extraordinary will to do things in the world were revived in a testimonial dinner given to Samuel Insull at the Palmer House, Chicago, on the evening of Feb. 28. Fifty years ago on the same date, Mr. Insull, aged 21 years, had arrived in America from England to be the secretary of Thomas A. Edison. To commemorate this event, about 700 of the directors and executives of the various operating and financial concerns which now constitute the so-called Insull group of public utility properties, were in attendance. They came from forty or more states and two foreign countries, Great Britain and Canada.

Grouped by states they sat at tables decorated with golden domes which later were removed to reveal replicas of the original Edison incandescent lamp. For a brief time the dinner continued with no other illumination than from these out-dated lamps.

John F. Gilchrist, vice-president of the Commonwealth Edison Company,

Samuel Insull

and the oldest "Edison" man, in point of service with an Edison organization in Chicago, was the master of ceremonies. The chief speaker of the evening may be said to have been Thomas A. Edison, who, by long distance telephone from Fort Myers, Fla., offered his congratulations to Mr. Insull and paid a tribute to his former secretary.

Other speakers were Samuel Insull, Jr., who briefly presented his father, and Mr. Insull, who confined himself entirely to the personal experiences of his half-century of citizenship in building an organization which employs 72,800 persons in groups with aggregate securities reaching a market value of more than three billion dollars.

Sixteen 1,000-Hp. Motors Ordered for Hudson Avenue

BROOKLYN EDISON COMPANY has just awarded to the Westinghouse Electric & Manufacturing Company a contract for sixteen 1,000-hp. electric motors, to be installed in the Hudson Avenue generating station as a part of the auxiliary equipment for units in that station.

The motors will be used to operate induced-draft fans. They are to be multi-speed, of the squirrel-cage type, each delivering 1,000 hp. at 1,170 r.p.m. They are designed for operation at 2,300 volts, 60-cycles, and will permit full voltage starting at each speed.

Delivery will start this month and be completed in November.

News of Canada

Manitoba plans 400,000-hp. project—Seek permit to increase Beauharnois capacity—Report progress of Saskatchewan system

ANNOUNCEMENT was made recently by Premier Bracken of Manitoba that the legislature of the province would be asked during the present session of parliament to approve an investigation into a proposal to carry out the largest individual power development ever constructed in the province. The project, he said, would develop probably 400,000 hp. by diverting the flow of the Saskatchewan River into Lake Winnipegosis, thence through Lake Manitoba and the Dauphin River to Lake Winnipeg. The development, as outlined, would be on the Dauphin River near Sturgeon Bay, which lies half way up the west coast of Lake Winnipeg, Manitoba's largest body of water. It would be within 140 miles of Winnipeg.

There is a very strong probability that the province of Manitoba will, in the near future, form a hydro commission, similar to that operating in the province of Ontario. Premier Bracken believes the time has come to place the Manitoba Power Commission on an independent administrative basis, entirely apart from government control. Legislation will be sought, he said, at the present session of the provincial parliament for appointment of a provincial hydro commission, "with powers similar to those under which the hydro has been developed so successfully in Ontario."

PREMIER TASCHEREAU of Quebec recently received a delegation representing the Beauharnois Power Company, which is seeking to obtain greater powers for the widening of the present canal so as to provide that an additional 135,000 hp. may be developed. At present the proposed development between Lakes St. Louis and St. Francis is 500,000 hp., most of which has already been contracted for, and the additional 135,000 hp. is needed for the development of local industries. The delegation was advised by Mr. Taschereau that an order-in-council would be passed shortly, permitting of the widening of the canal, so that the power development can be increased as requested.

STRIKING PROGRESS during the last year is revealed in the annual report of the Saskatchewan Power Commission, which shows 1,096 miles of transmission lines built in the comparatively short period of twelve months. While the commission's principal generating station remains the former municipally-owned steam-electric plant at Saskatoon, purchased at the beginning of operations two years ago and subsequently enlarged, notable progress has been made in acquiring many other plants and con-

necting towns to the rapidly growing network of transmission lines. The commission, last year, purchased small plants and equipment in 35 different towns and entered into agreements with 87 towns and villages for the supply of electricity.

The report sets out that the total generating capacity of all plants owned by the Saskatchewan Power Commission is 26,325 kw., while the capacity of all municipally-owned plants in the province is 37,024 kw., and that of all privately-owned plants 29,227 kw. Of the commission's generating plants 21,925 kw. is represented in steam-plant capacity and 4,400 kw. in Diesel plants.

While the commission has no water-power development, a possible hydro-electric power site near Fort a la Corne on the North Saskatchewan River, 17 miles northeast of Kinistino, is now under consideration. Borings into the banks and bed of the river are being made as well as a survey of lands likely to be flooded should the development be proceeded with.

Lt.-Gen. Jadwin, Former Chief Of Army Engineers, Dies

LIEUTENANT-GENERAL EDGAR B. JADWIN, former chief of engineers of the United States Army, died unexpectedly March 2 of a cerebral hemorrhage in Balboa, Canal Zone, where he had gone on Feb. 25 to investigate the possibility of constructing a Nicaraguan canal or enlarging the capacity of the Panama Canal.

Born in Honesdale, Pa., on Aug. 7, 1865, General Jadwin had a remarkable record as a scholar, soldier, and builder. He had been connected with some of the most important engineering enterprises of this country. Among other projects he is credited with housing the American Expeditionary Forces during the World War; it was his plan for flood control on the Mississippi which was adopted by Congress after the 1927 flood; as consulting engineer of the Meadows Reclamation Commission he was author of the recently announced plan for creating a new port city on the Hackensack Meadows; it was he who built the Galveston sea wall.

Last summer President Hoover suggested him as chairman of the newly reorganized Federal Power Commission, but he was unable to serve due to the pressure of other duties. He was chairman of the engineering board of the New York-St. Lawrence Power Development Commission and proponent of the plan for a dam between Massena, N. Y., and Cornwall, Ont. As chairman of the Inter-Oceanic Canal Board he sailed for Panama Feb. 17 and was to advise Congress as to whether a new canal through Nicaragua should be undertaken or the Panama Canal enlarged.

General Jadwin was made chief of army engineers in 1927 and retired in 1929 to engage in other activities.

COMING CONVENTIONS

American Society of Mechanical Engineers. Semi-annual meeting in Birmingham, Ala., Apr. 20-23. Meeting at Hartford, Conn., June 1-3. National Oil and Gas Power Meeting at the University of Wisconsin, Madison, Wis., June 15-16. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Institute of Electrical Engineers. District meeting in Pittsburgh, Pa., March 11-13. District meeting in Rochester, N. Y., Apr. 29-May 2. Annual summer convention in Asheville, N. C., June 22-26. Secretary, F. L. Hutchinson, 33 West 39th St., New York City.

American Society of Refrigerating Engineers. Spring meeting at the Hotel President, Kansas City, Mo., May 6-8. Secretary, David L. Fiske, 37 West 39th St., New York City.

American Society for Testing Materials. Annual meeting at the Stevens Hotel, Chicago, Ill., June 22-26. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Welding Society. Annual meeting in New York City, Apr. 22-24. Secretary, M. M. Kelly, 33 West 39th St., New York City.

American Refractories Institute. Annual spring meeting at The Greenbrier, White Sulphur Springs, W. Va., May 18-19. Secretary, Dorothy A. Texter, Oliver Building, Pittsburgh, Pa.

Association of Iron and Steel Electrical Engineers. Annual meeting and exposition at the Cleveland Public Auditorium, Cleveland, Ohio, June 15-19. Managing director, John F. Kelly, Empire Building, Pittsburgh, Pa.

1931 Midwest Bituminous Coal Conference. To be held at the University of Illinois, Urbana, Ill., May 21-22. Chairman of Program Committee, B. R. Gebhart, Illinois Coal Bureau, 307 North Michigan Ave., Chicago, Ill.

National Association of Power Engineers. Annual convention and mechanical exposition in the Convention Hall, Kansas City, Mo., Sept. 7-11. Secretary, Fred W. Raven, 417 South Dearborn St., Chicago, Ill.

National District Heating Association. Annual convention at the Hotel Statler, Boston, Mass., June 2-5. Secretary, D. L. Gaskill, Greenville, Ohio.

National Electric Light Association. Annual convention in the Atlantic City Auditorium and Convention Hall, Atlantic City, N. J., June 8-12. Secretary, A. Jackson Marshall, 420 Lexington Ave., New York City.

Third International Conference on Bituminous Coal. At Carnegie Institute of Technology, Pittsburgh, Pa., Nov. 16-21. Chairman, Thomas S. Baker, president of Carnegie Institute of Technology.

Universal Craftsmen Council of Engineers. Annual convention at the Sherman Hotel, Chicago, Ill., Aug. 4-8. Secretary of Convention Committee, James J. Blaine, 7342 Harvard Ave., Chicago, Ill.

HARRY P. READMON, for the past twelve years purchasing agent of the Chicago Pneumatic Tool Company of New York City, died on Feb. 26. He was 53 years old.

Personals

DR. WILLIAM J. FOSTER, retired consulting engineer of the General Electric Company, has been awarded the Lamme Medal of the American Institute of Electrical Engineers for his contributions to the design of rotating alternating-current machinery. Presentation of the medal will take place at the summer convention of the institute, which is to be held in Asheville, N. C., June 22-26. Dr. Foster began his engineering career in 1891 at the Thomson-Houston works in Lynn, Mass., where he engaged in development work on induction motors and synchronous converters. He was closely associated in his work with both DR. STEINMETZ and DR. H. G. REIST, and for 25 years, beginning 1895, he had general charge of the electrical designs of all alternating-current machinery built by the General Electric Company.

E. W. HALL, mechanical superintendent of the Saskatchewan Co-operative Creameries, Ltd., of Regina, has resigned to take a position as superintendent of construction and maintenance for the Dairy Corporation of Canada, with headquarters at Toronto, Ont. Previous to his association with dairy interests, Mr. Hall was power-house superintendent of the Swift Current steam plant.

H. H. BAILEY, formerly superintendent of power production of the Tennessee Electric Power Company, is now assistant manager of the company's Chattanooga district. Before his connection with the Tennessee company, Mr. Bailey was associated with the Nashville Railway & Light Company for fourteen years.

C. REA MOORE, for many years connected with the engineering staff of the Department of Public Works of Olympia, Wash., has joined the Washington Water Power Company as manager of the Okanogan division.

E. A. HESTER, formerly planning engineer of the Duquesne Light Company, has been placed in charge of the newly formed operating-systems planning division of the vice-president's and general manager's office. He will take over the duties previously handled by E. C. STONE, formerly system development manager, who has been promoted to the position of assistant to the president. Before joining the Duquesne company in 1926, Mr. Hester was associated with the Brooklyn Edison Company, where he acted as resident engineer in charge of the construction of the Hudson Avenue generating station.

D. W. PROEBSTEL, for many years test engineer with the Portland General Electric Company, Portland, Ore., has been promoted to the engineering department of the parent company, Central Public Service Corporation of Chicago, where he will be assistant to L. N. BOYSEN, who is assistant to the operating vice-president.

Business Notes

CHAIN BELT COMPANY, Milwaukee, Wis., announces changes in the personnel of its Cleveland, Buffalo, St. Louis, Portland, and Seattle offices. Mr. Smallshaw, formerly in charge at the St. Louis office, is now in charge of the Cleveland office; Thomas Cocker, manager of the Cleveland office, has been placed in charge of the Buffalo office; and Frank Gary has been transferred from the Buffalo office to St. Louis. On the Pacific Coast, Hy Bergis has been transferred from the Seattle to the Portland office, and Gerald Nichols of the Portland office will take charge at Seattle. W. F. Nichols continues as Northwest manager.

CLAUD S. GORDON STEEL X-RAY LABORATORY has been recently organized in Chicago to furnish a complete service in X-raying steel, iron, and metal up to a thickness of 4½ in. Its equipment is capable of handling any sized piece of metal from the smallest to the largest casting or pressure shell, it is announced. The new laboratory is located at Western Ave. and 15th Pl., Chicago, with general offices in that city at 708 West Madison St., and a branch at 1988 East 66th St., Cleveland, Ohio.

BLACKMER PUMP COMPANY, Grand Rapids, Mich., announces that its annual stockholders meeting was held on Feb. 9, which marked the close of one of the most successful years in the firm's history. Officers elected at the meeting were: A. B. Klise, president; George C. Schaffer, vice-president; and M. C. Klise, secretary-treasurer. Present indications lead the company to believe that 1931 will be another very successful year, it is stated.

How's Business?

BUSINESS ACTIVITY has shown at the most only a feeble seasonal expansion so far. Our index has drifted downward through February, and at the beginning of March stands at 77.4 per cent of normal, only a little above the low point of December. Commodity prices are still sagging, even seasonal credit expansion is lagging, and spring stock market enthusiasm is flagging. Cotton and textiles are the brightest spots in the picture. Adjournment of Congress till December leaves business, bankers and government to their own devices; but the absence of any sign of plan or policy on their part, contrasted with the stir of constructive activity abroad, arouses wonder whether the assumed initiation of recovery here may not be another case of kidding ourselves along.—*The Business Week*, March 11.

WITH THE SOCIETY SECTIONS

A.S.M.E., Baltimore Section. Meeting at the Engineers' Club on March 12. Subject: "The Modern Locomotive and the Development of the Water-Tube Boiler," by Samuel M. Vauclain, Baldwin Locomotive Company.

A.S.M.E., Philadelphia Section. Meeting at the Engineers' Club on March 24 at 8 p.m. Subject: "Design, Construction, and Operation of Mercury-Vapor Generating Units," B. P. Coulson, Jr., and H. N. Hackett, General Electric Company.

A.S.M.E., Schenectady Section. Meeting at the Edison Club on March 12 at 8 p.m. Subject: "The Packard Diesel Aircraft Engine," by M. J. Steele, Packard Motor Car Company.

A.S.M.E., Syracuse Section. Meeting at the Onondaga Hotel roof garden on March 30 at 8 p.m. Subject: "Some Phases of the Present Economic Situation as It Pertains to Unemployment," by Ralph E. Flanders, Jones & Lamson Machine Tool Company.

New England Water Works Association. Meeting at the Hotel Brunswick, Boston, Mass., March 11 at 1 p.m. Subjects: "Practical Points on Operation of Pumping Stations for Town Water Works," by Charles E. Greene, Metcalf & Eddy; "Rebuilding No-Town Dam of Leominster Water Works," by W. Guy Classon, Leominster.

Trade Catalogs

FEED-WATER REGULATOR — Complete details of the Campbell feed-water regulator are contained in a new bulletin just issued by the Atlas Valve Company, 282 South St., Newark, N. J. Information on installation of the regulator and a full list of valves of various designs is also included in this illustrated booklet.

DUST COLLECTOR—Prat-Daniel Corporation, 183 Madison Ave., New York City, has just issued a new bulletin describing and illustrating the new Thermix Type V multi-cyclone dust collector.

WELDING—Detailed information on the applications of Lukenweld construction to the manufacture of housings, bases, beds, gear cases, and other machine parts, is given in an illustrated bulletin recently issued by Lukenweld, Inc., division of Lukens Steel Company, Coatesville, Pa.

SPEED REDUCERS—Catalog No. 135 of the D. O. James Manufacturing Company, 1120 West Monroe St., Chicago, Ill., presents complete details of four sizes of small heavy-duty worm-gear speed reducers. Besides much engineering data, the catalog contains many illustrations of actual installations.

MOTORS—A detailed discussion of the mechanical and electrical characteristics of slip-ring motors together with information on their control equipment is given in Bulletin 169 recently issued by the Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo.

WELDING—Bulletin No. 3304 just issued by the Lincoln Electric Company, Cleveland, Ohio, describes and illustrates a full line of arc-welding supplies, including welding rods, electrodes and holders, cable and cable accessories, shields, protective clothing, repair parts, and instruction books.

PIPING—Information regarding the practice and theory of bending wrought iron pipe is contained in a new 16-page illustrated bulletin, No. 50, published by the A. M. Byers Company, Clark Building, Pittsburgh, Pa.

Fuel Prices

FUEL OIL

New York—Mar. 5, f.o.b. Bayonne, N. J., 28@34 deg. Baumé, industrial use, tank-car lots, 4.5c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, contract, 6c. per gal.

St. Louis—Feb. 11, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.339 per bbl., or 42 gal.; 26@28 deg., $1.464 per bbl.; 28@30 deg., $1.589 per bbl.; 30@32 deg., $1.689 per bbl.; 32@36 deg., gas oil, 3.776c. per gal.; 38@40 deg., distillate, 4.526c. per gal.

Pittsburgh—March 4, f.o.b. local refinery, 34@36 deg., fuel oil, 3.125c@ 3.5c. per gal.; 36@40 deg., 3.125c.@3.5c.

Pittsburgh — Mar. 4, f.o.b. local re- $1.31 per bbl.; No. 5, medium, $1.22; No. 6, heavy (Bunker C) $1.10.

Cincinnati—Feb. 24, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 4.5c. per gal.; 26@30 deg., 4.75c. per gal.; 30@32 deg., 5c. per gal.

Chicago—Feb. 26, tank-car lots, f.o.b. Oklahoma; freight to Chicago, 90c. per bbl. or 42 gal.; 18@22 deg., 53.75c. per bbl.; 22@26 deg., 62.5c. per bbl.; 26@28 deg., 72.5c. per bbl.; 28@30 deg., 83.75c. per bbl.

Boston—Mar. 2, tank-car lots, f.o.b. 12@14 deg., Baumé, 2.95c. per gal.; 28@ 32 deg., 4.95c. per gal.

Dallas—Feb. 28, f.o.b. local refinery 24@26 deg., $1.10 per bbl. or 42 gallons.

COAL

Bituminous (Net Tons)	At Mine, for Shipment to	Price per Ton
Pool 9, super low-vol..	New York...	$1.90 @$2.25
Pool 10, h. gr. low-vol.	New York...	1.75 @ 1.85
Pool 11, low-vol.....	New York...	1.60 @ 1.75
Smokeless, mine-run..	Chicago.....	1.75 @ 2.00
Smokeless, slack.....	Chicago.....	.75 @ 1.35
Harlan, Ky., slack....	Chicago.....	.70 @ 1.00
Franklin, Ill., mine-run	Chicago.....	2.15
Franklin, Ill., screen...	Chicago.....	1.50 @ 1.60
Ind. 5th Vein, m.-r....	Chicago.....	1.20 @ 1.75
Standard Ill., mine-run	St. Louis.....	1.25 @ 1.65
W. Ky., mine-run	Louisville....	.90 @ 1.25
W. Ky., slack.....	Louisville ...	.55 @ .85
Pittsburgh, mine-run.	Pittsburgh....	1.30 @ 1.60
Smokeless, mine-run..	Cincinnati...	1.75 @ 2.00
Smokeless, slack.....	Cincinnati...	1.00 @ 1.25
Kanawha, mine-run..	Cincinnati...	1.00 @ 1.35
Kanawha, nut-slack.	Cincinnati...	.65 @ .90

Anthracite (Gross Tons)	At Mine, for Shipment to	Price per Ton
Buckwheat.....	New York...	$3.50
Barley.....	New York...	1.50

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Exeter—City plans an election to vote $24,000 bonds for waterworks system including pumping plants, storage tank, etc.

Calif., Long Beach—Southern California Edison Co., 306 West 3rd St., Los Angeles, awarded contract for the design and construction of third unit of steam power plant, 135,000 hp. capacity, including two 262 ft. stacks, here, to Stone & Webster, 510 Homer Laughlin Bldg., Los Angeles. Estimated cost $7,500,000. Equipment will include condensers, generators, transformers, water pump, draft fans, boilers, evaporators, fuel oil heating, feed pumps, etc. H. F. Hendrickson, Local Manager, will supervise construction.

Calif., San Francisco—Bd. of Harbor Commission, Ferry Bldg., will receive bids until Mar. 19, for addition to cold storage and refrigeration plant, including machinery and equipment at Channel and 3rd St.

Conn., West Haven—New Haven Water Co., awarded contract for the construction of a waterworks pumping station at Jones Hill Road to W. H. Crute, 91 Howe St., New Haven. Estimated cost $15,000.

Ill., Aurora — Schmidt, Garden & Ericksen, 104 South Michigan Ave., Chicago, Archts., will receive bids until Mar. 25 for the construction of a hospital, including power plant and laundry at Lincoln and Weston Aves. for Copley Hospital, Aurora. $400,000.

Ind., Newcastle—Village of Epileptics, will receive bids until Mar. 13 for the construction of a power plant, including boilers, stokers and turbine generators. Estimated cost $40,000. Foltz, Osler & Thompson, 1037 Architects and Builders Bldg., Indianapolis, are architects. Bevington-Williams Inc., 1139 K. of P. Bldg., Indianapolis, are engineers.

Ind., St. Meinard—St. Meinard Abbey, will build three transformer stations. Estimated cost $40,000. E. C. Berendes, 121 Northwest 4th St., Evansville, is engineer.

La., New Orleans — Bd. of Supervisors, Louisiana State University, Baton Rouge, will receive bids until Mar. 30 for the construction of a 7 story medical building, including steam heating and mechanical equipment, elevators, etc., here. Weiss, Dreyfous & Seiferth, Inc., Maison Blanche Bldg., New Orleans, are architects.

La., Oakdale—City, c/o J. M. Jones, plans an election Mar. 24 to vote $90,000 bonds for the construction of an electric light and power plant.

Me., Portland—Cumberland County Power & Light Co., 443 Congress St., plans to expend $75,000 on conduit construction at Bramhall, Vaughan and High Sts. and Cumberland Ave.

Mass., East Longmeadow — Central Massachusetts Electric Co., 406 Main St., Palmer, will build a power sub-station here. Estimated cost $50,000 including equipment. Private plans. Work will be done by owner's forces.

Mass., Lowell—City plans addition and alterations to pumping station on West Sixth St. Estimated cost $40,000. Private plans.

Mass., Raynham—Bd. of Selectmen, plans the construction of a waterworks system, including pumping station, mains, etc. Estimated cost $200,000. Whitman & Howard, 89 Broad St., Boston, are engineers.

Mich., Dearborn — Bd. of Water Commissioners, L. P. Fisher, Pres., 735 Randolph St., Detroit, will receive bids until Mar. 24 for power plant structures, including switch house and turbine house superstructures, part of boiler plant substructure and entire superstructure, control house connecting pumping plant and switch house on West Warren Ave. at Detroit Terminal Railroad here.

N. J., Jersey City—Springarn Realty Co., J. Springarn, Pres., 590 Summit Ave., will receive bids about April 1 for the construction of a 9 story office and stores building, including steam heating and ventilation systems, boilers, elevators, etc., at Newark and Oakland Aves. Estimated cost $750,000. W. Neumann, 26 Journal Sq., is architect and engineer.

N. J., Holmdel — Dept. of Institutions & Agencies, W. Ellis, Comr., State Office Bldg. Annex, Trenton, will receive bids until Mar. 16 for the construction of a reception and treatment hospital, including steam heating and ventilation systems, boilers, etc., at New Jersey State Hospital here. Estimated cost $800,000.

N. J., Perth Amboy—Bd. of Commissioners, City Hall, postponed construction of electric light plant addition. $40,000. Maturity probably in May.

N. Y., Bedford Hills — Dept. of Correction, State Capitol, Albany, will receive bids until Mar. 26 for the construction of cold storage plant, laundry, etc., at New York State Reformatory for Girls here. Estimated cost to exceed $40,000.

N. Y., Central Islip — Dept. of Mental Hygiene, State Capitol, Albany, received low bids for construction work, service connections (tunnels), additional power house, etc., at Central Islip State Hospital here.

N. Y., New York—Dept. of Water, Gas & Electricity, J. J. Dietz, Comr., is having plans prepared for the construction of a pumping station to facilitate the transport of water from Croton and Ashokan reservoirs. Estimated cost $500,000.

N. Y., West Haverstraw—Dept. of Standards & Purchase, Albany, will receive bids until April 16 for storehouse, dining room, kitchen and refrigeration plant at New York State Orthopedic Hospital here. Estimated cost to exceed $100,000.

O., Springfield—City will receive bids until Mar. 9 for the construction of a 4 story hospital. Estimated cost $1,500,000. M. W. Lethley and Eastman & Budke are associate architects.

Okla., Shawnee—E. A. Liebman, 1214 West 18th St., Oklahoma City, is having preliminary plans prepared for the construction of a raw water ice plant here. Estimated cost $90,000. Private plans.

Okla., Fairfax—City defeated bond election for $120,000 for the construction of a municipal light plant. Long & Co., Colcord Bldg., Oklahoma City, Engrs.

Ore., Portland—City Council, retained Carey & Harlan, Failing Bldg., Industrial Engrs., to make a power survey covering report on preliminary estimated costs and availability and capacity of the various power sites in the vicinity. $25,000.

Pa., Colona—Pittsburgh & Lake Erie R.R., Pittsburgh and Lake Erie Terminal Building, Pittsburgh, plans the construction of a rail river terminal, including mechanical coal handling equipment. A. R. Raymer is chief engineer.

Pa., Philadelphia—Philadelphia Electric Co., 10th and Chestnut Sts., awarded contract for the construction of a 95 x 170 ft. power plant at Taber and Adams Aves. to United Engineers & Constructors, Inc., 112 North Broad St. Estimated cost $103,000.

Pa., Philadelphia — Philadelphia Co., G. F. Holmes, Pres. Boro of County Comrs., City Hall, plans the construction of a municipal court building at Parkway. Estimated cost $3,250,000. J. T. Windrim, Commonwealth Bldg., is architect.

R. I., Newport—Bureau of Yards & Docks, Navy Dept., plans extensions and improvements to power plant at Naval Training Station. Estimated cost $50,000. Private plans.

Tenn., Nashville—State is having preliminary plans prepared for the construction of a group of buildings, including administration and auditorium, etc. Estimated cost $1,000,000. W. R. McCornack, 10006 Carnegie Ave., Cleveland, O., is architect.

Tex., Beaumont — Hotel Dieu Hospital, operated by Sisters of Charity of Incarnate Word Academy, 609 Crawford St., Houston, plans the construction of a hospital and nurses' home, including steam heating, ventilation and refrigeration systems, boilers, elevators, etc. Estimated cost $500,000. Private plans.

Tex., El Paso—J. O. Hamilton, Las Cruce, New Mex., & Associates, plans the construction of a dry ice plant here. Estimated cost $50,000. Private plans.

Tex., San Marcos—City is having plans and surveys made for the construction of a sewage treatment plant, including disposal plant, pumping station, etc. Estimated cost $90,000. Montgomery & Ward, Wichita Falls, are consulting engineers.

Tex., Waco—U. S. Veterans Bureau, Arlington Bldg., Washington, D. C., received low bids for the construction of a group of hospital buildings, including boiler plant, refrigeration and ice making plant, etc., at U. S. Veterans Hospital here.

Wis., Racine—St. Mary's Hospital, is having revised plans prepared for the construction of a group of hospital buildings, including nurses' home, power plant, etc. Estimated cost $1,500,000. V. J. Klutho, 910 Syndicate Trust Bldg., St. Louis, Mo., is architect.

Equipment Wanted

Electrical Equipment — Wilmington, Del. — U. S. Engineer Office, Washington, D. C., will soon receive bids for alternating current electrical equipment for four bridges on Chesapeake and Delaware Canal, here.

Generating Unit—Cliffside Park, N. J.—Bd. of Council, Boro Hall, will receive bids about Mar. 15 for furnishing and installing a generating unit machine in pumping station at Aurora St. and West End Ave.

Generators—Brooklyn, N. Y.—Signal Supply Officer, New York General Depot, Army Base, will receive bids until Mar. 31 for eighteen motor generators. U. S. Army Spec. 285-E.

Pump—Seneca, Pa.—City plans to purchase pump, etc., in connection with proposed waterworks improvements.

Pump, etc.—San Diego, Calif.—Public Works Officer, 11th Naval District, will receive bids until Mar. 19 for improvements to gasoline storage facilities including pumps, electric light and power systems, etc.

Pumping Equipment—Martin, S. D.—City will receive bids until Mar. 18 for pumping equipment for waterworks improvements. Estimated cost $32,000.

Industrial Projects

Calif., Santa Ana—Villa Park Orchards Association, plans the construction of a 2 story precooling plant. Estimated cost $75,000. Architect not selected.

Calif., Tustin—Tustin Hills Citrus Association, awarded contract for the construction of a pre-cooling plant to J. W. Markel & Sons, Builders Exchange, Santa Ana. $90,000. Precooling system to York Ice Machinery Corp., 5051 Santa Fe Ave., Los Angeles.

Me., Dixfield—Berst-Foster-Dixfield Co., F. W. Smith, Mgr., West Peru, manufacturers of wood products, is having preliminary plans prepared for a 2 story addition to factory. Estimated cost $40,000. Private plans.

Mass., Taunton—Taunton Pearl Works, 35 Vernon St., is receiving bids for remodeling 2 story plant. Estimated cost $50,000. Jackson & Moreland, Park Sq. Bldg., Boston, are architects.

Mich., Marysville — Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa., plans the construction of a glass manufacturing plant and terminal here. Estimated cost to exceed $200,000. Maturity indefinite.

Mich., Mohawk—Seneca Copper Mining Co., 11 Park Pl., New York, N. Y., plans the construction of a rock house, compressor plant and pumping station here. Estimated cost to exceed $100,000.

Miss., Jackson—International Match Co., 25 West 43rd St., will soon award contract for the construction of a 1 story factory including two warehouses and five outbuildings here. Estimated cost $80,000. N. W. Overstreet, Mississippi Fire Insurance Bldg., is architect.

N. J., East Rutherford — East Rutherford Syringe Co., 75 Mozart St., postponed construction of a 2 story factory at 54 Mozart St. $40,000. J. T. Camlet, 26 Piaget Ave., Clifton, Archt. Indefinite when project will mature.

N. J., Jersey City—Jersey City Ladder Co., Inc., 677 Montgomery St., will not construct 2 story, 45 x 140 ft. factory on Crawford St. Estimated cost $50,000. B. Singer, 921 Bergen Ave., Archt. Project abandoned.

N. J., New Brunswick—Metallo Gasket Co., 16 Bethany St., awarded contract for a 2 story addition to factory to Milltown Realty & Construction Co., Main St., Milltown. Estimated cost $40,000.

R. I., Providence — C. M. Stone Co., N. Stone, 456 Benefit St., is receiving bids for the construction of a 2 story leather finishing plant on Winchendon St. Estimated cost $50,000. F. E. Field, 5 Euclid Ave., is architect.

Tex., Beaumont—Wilson Packing Co., U. S. Yards, plans the construction of a 2 story, 75 x 150 ft. cold storage warehouse at Crockett and Jefferson Sts. Estimated cost $85,000. Work will start soon.

B. C., Vancouver—Ford Motor Car Co. of Canada Ltd., 1160 Hamilton St., is having plans prepared for the construction of an assembly plant at Burnaby Way. Estimated cost $1,000,000. Private plans.

B. C., Victoria—Cameron Lumber Co. Ltd., plans to rebuild saw mill at Inner Harbour recently destroyed by fire. Estimated cost including equipment $200,000. Private plans.

Que., St. Hyacinthe—Hump Hairpin Co., 1918 Prairie Ave., Chicago, Ill., will soon award contract for the construction of a factory here. Estimated cost $125,000 to $150,000.

PRICES - MATERIALS - SUPPLIES

Electrical prices on following page are to the power plant by jobbers in the larger buying centers east of the Mississippi. Elsewhere the prices will be modified by increased freight charges and by local conditions.

SINCE LAST MONTH

THE market for electrical and power-plant supplies experienced many declines and few advances, during February. Buying of industrial equipment and other electrical goods has declined steadily since the early part of 1929, with the exception of a slight spurt, which occurred about a year ago. While rubber-covered copper wire and linseed oil, advanced last month, substantial reductions occurred in prices of anti-friction babbitt, conduit, elbows, couplings, armored cable, enclosed switches, friction and rubber tape.

POWER-PLANT SUPPLIES

HOSE—Quotations at New York warehouses:

	Fire Protection	50-Ft. Lengths
Underwriters' 2½-in., coupled, single jacket, net, per ft		$0.59
Common, 2½-in., cotton, rubber-lined, 80c. per ft., list, less		60%
	Air—Best Grade, Net	
¼-in., per ft	3-ply $0.27	4 ply $0.32
	Steam—Discounts from List	
First grade.. 50–10%	Second grade.. 50–10–5%	Third grade.. 60–10–5%

RUBBER BELTING—List price, 6-in., 6 ply, $1.83 per lin.ft. The following discounts from New York warehouse list apply to rubber transmission belting:

Best grade 70% Second grade 65-5%

LEATHER BELTING—List price, 24c. per lin.ft., per inch of width, for single ply, at New York warehouses in quantities of about ½ doz. rolls:

Grade	Discount from list
Medium	30-10%
Heavy	30%

RAWHIDE LACING
- Cut lacing, best quality, 30-10%; 2nd quality, 50%.
- Lace leather sides, best, 12-17 sq.ft., 55c. per sq.ft.; 2nd, 48c., net.
- Giant or Indian tanned cut lacing, 30-10%.

PACKING—Prices per pound at New York warehouses:

Rubber and duck for low-pressure steam, ⅛ in.	$0.90
Asbestos for high-pressure steam, ⅛ in.	1.75
Duck and rubber for piston packing	.90
Flax, regular	1.15
Flax, waterproofed	1.70
Compressed asbestos sheet	.85
Wire insertion asbestos sheet	1.20
Rubber sheet	.45
Rubber sheet, wire insertion	.75
Rubber sheet, duck insertion	.55
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.40
Asbestos wick, ½- and 1-lb. balls	.50

PIPE AND BOILER COVERING—Discounts from list at New York warehouses are as follows:

85% magnesia, high pressure		40 %
Asbestos, air cell, for low-pressure heating and return lines	4-ply	65 %
	3-ply	67½%
	2-ply	70 %

PORTLAND CEMENT—New York, $2.10 per bbl., without bags, delivered by truck to site of job. Bag charge, 40c. per bbl. in cloth.

STRUCTURAL STEEL—New York delivered price, beams and channels, 3 to 15-in.; angles, 3 to 6-in., ¼-in. thick; tees, 3-in. and larger; and plates, ¼-in. thick and heavier; all $3.10 per 100 lb. in lots of 400 to 3,999 lb.

COTTON WASTE—The following prices are in cents per lb., at warehouse:

	New York	Cleveland	Chicago
White	13.00	16.00	15.00
Colored	9.50	12.00	10.00

WIPING CLOTHS—Prices per pound in lots of about 600 lb., for washed, white wipers, as follows:

Chicago (100 lb. bales)	$0.14½
New York (100 lb. bales)	.15
Cleveland (per thousand)	38.00

LINSEED OIL—These prices are for raw oil in barrels, f.o.b., in 1 to 4 bbl. lots:

	New York	Minneapolis	Chicago
Per pound	$0.10	$0.107	$0.104

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b., New York:

	Dry	In Oil
Red	$13.25	$14.75
White	13.25	13.25

RIVETS—The following quotations apply on fair-sized orders from warehouse:

Tank rivets, ½-in. diameter and smaller, list less 60–10% in full packages, for immediate delivery from warehouse stocks in New York and vicinity.

Structural rivets, ½-in., round head, full kegs, per 100 lb.:

New York	$4.25
Chicago	4.00
Pittsburgh mill	2.75

Broken kegs, about $1.50 higher.

REFRACTORIES—Prices in car-loads, f.o.b. plant:

Chrome brick, eastern shipping points	per net ton	$45.00
Chrome ore, ground, 40@50%, Cr_2O_3, in bulk	per net ton	22@25
Chrome ore, ground, 40@50%, Cr_2O_3, in sacks	per net ton	26@29
Chrome ore, crude, 40@50%, Cr_2O_3	per net ton	18.00@22.50
Magnesite brick, 9-in. straights	per net ton	65.00
Magnesite brick, 9-in. arches, wedges and keys	per net ton	71.50
Magnesite brick, soaps and splits	per net ton	91.00
Silica brick, Mt. Union, Pa	per M	43.00
Clay brick, 1st quality, 9-in. shapes, Pennsylvania	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Ohio	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Kentucky	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Maryland	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Colorado	per M	40@43
Clay brick, 2nd quality, 9 in. shapes, Pennsylvania	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Ohio	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Kentucky	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Maryland	per M	35@38

BABBITT METAL—Delivered in case lots from New York warehouse, on orders of 100 lb. or over, cents per pound:

Genuine, highest grade	45.25
Commercial genuine, intermediate grade	34.25
Anti-friction metal, general service	29.00
No. 4 babbitt, f. o. b.	10.00

COLD-FINISHED STEEL—Warehouse prices on shafting and screw stock, per 100 lb., base, are as follows:

	New York	Cleveland	Chicago
Round or hexagon	$3.40	$3.65	$3.35
Flat or square	3.90	4.15	3.85

BOILER FITTINGS—Discounts from list at warehouse:

Copper ferrules	70%
Boiler flanges	65–5%
Boiler stay bolts	60%
Boiler patch bolts	20%
Boiler fitting-up bolts	45%
Pressed steel boiler lugs	10%

WROUGHT PIPE—The following basing discounts from list are for large mill lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	64%	52½%	1 and 1¼	30%	13%

LAP WELD

2	57%	45½%	2	23%	7%
2½ to 6	61%	49½%	2½ to 3	26%	11%
7 and 8	58%	45½%	3½ to 6	28%	13%
9 and 10	56%	43½%	7 and 8	26%	11%
11 and 12	55%	42½%	9 to 12	26%	11%

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	62%	51½%	1 to 1½	30%	14%
2 to 3	63%	52½%			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	55%	44½%	2	23%	19%
2½ to 4	59%	48½%	2½ to 4	29%	15%
4½ to 6	58%	47½%	4½ to 6	28%	14%
7 and 8	54%	41½%	7 and 8	21%	7%
9 and 10	47%	34½%	9 to 12	16%	2%
11 and 12	46%	33½%			

BOILER TUBES—Standard gage, manufactured in accordance with the specifications and requirements of the American Society of Mechanical Engineers and in compliance with the rules and regulations of the U. S. Steamboat Inspection Service, from New York warehouse stock, per 100 ft.:

Size, Inches*	B.W.G.	Toncan Seamless Iron	Knobbled Charcoal Iron	Seamless Steel	Lapwelded Steel
1	13	$34.00	.....	$18.00	.....
1¼	13	37.75	.....	20.25	.....
1½	13	38.00	$38.00	19.25	.....
1¾	13	30.00	30.00	22.00	.....
2	13	26.25	26.25	20.25	$19.00
2¼	13	34.50	34.50	23.00	25.00
2½	12	34.00	34.00	26.00	24.25
2¾	12	40.50	40.50	28.50	27.50
3	12	42.50	42.50	27.00	25.50
3¼	11	50.25	50.25	30.75	28.75
3½	11	54.50	54.50	33.25	31.50
4	10	67.00	67.00	40.00	38.00

These prices are based on stock lengths. If cut to special lengths billing will be based on the entire stock lengths. In addition to the foregoing, standard cutting charges are as follows:

2-in. and smaller.. $0.05 per cut
2¼ and 2½ in..... .06 per cut
3-in..... $0.09 per cut
3¼ to 4 in.. .10 per cut

*External diameter.

ELECTRICAL SUPPLIES

ARMORED CABLE—Price per 1,000 ft., New-Style, A.B.C., with fibre bushing:

B. & S. Size	BX Two Cond. M. Ft.	BX Three Cond. M. Ft.	Lead Two Cond. M. Ft.	Lead Three Cond. M. Ft.
No. 14 solid....	$22.00	$36.00	$66.00	$86.75
No. 12 solid....	38.02	50.52	76.00	104.00
No. 10 solid....	52.10	66.22	95.00	124.00
No. 8 stranded..	85.34	105.22	133.00	185.00
No. 6 stranded..	123.58	148.81	180.00	253.00

Coils to 1000 ft., +10%; less than coil lots, +20%.

CONDUIT—Rigid iron, price per 1,000 ft.; **ELBOWS AND COUPLINGS,** per 100 pieces, extra. Delivered from New York warehouse. Discount of 5 per cent for payment in 10 days; 30 days net.

Size, Inches	GALVANIZED Conduit	GALVANIZED Elbows	GALVANIZED Couplings	BLACK Conduit	BLACK Elbows	BLACK Couplings
½	$57.80	$8.05	$4.63	$52.96	$6.96	$4.23
¾	73.83	10.59	6.61	67.28	9.16	6.04
1	105.91	15.67	8.59	96.22	13.56	7.85
1¼	143.29	21.20	12.04	130.18	18.63	11.08
1½	171.33	28.26	14.88	155.65	24.84	13.68
2	230.51	51.81	19.84	209.42	45.54	18.24
2½	364.46	84.78	28.34	331.11	74.52	26.06
3	476.60	226.08	42.51	432.99	198.72	39.09
3½	599.38	499.26	56.68	546.94	438.84	52.12
4	730.85	576.98	70.85	668.72	507.15	65.15
4½	851.54	873.71	106.28	779.15	767.97	97.72
5	992.34	1212.83	116.90	907.98	1066.05	107.50
6	1287.36	1507.20	170.04	1177.92	1324.80	156.36

CONDUIT BODIES AND FITTINGS—Black or galvanized:

	Less Than $15 List	$15 List to $100	$100 List and Over
Standard package	15%	20%	28%
Less than standard package	10%	15%	20%

CUT-OUTS—Following are net prices, each, in standard-package quantities:

CUT-OUTS, PLUG, SOLID, NEUTRAL OR 2-FUSE

S. P. M. L.	$0.12	D. P. D. B.	$0.31
D. P. M. L.	.16	T. P. S. B.	.35
T. P. M. L.	.27	T. P. D. B.	.47
D. P. S. B.	.16		

CUT-OUTS, N. E. C. FUSE, SOLID, NEUTRAL OR 2-FUSE

	0-30 Amp.	31-60 Amp.	60-100 Amp.
D. P. M. L.	$0.27	$0.70	$1.75
T. P. M. L.	.40	1.00	2.30
D. P. S. B.	.35	.87	.....
T. P. S. B.	.67	1.50	.....
D. P. D. B.	.65	1.75	.....
T. P. D. B.	1.12	3.00	.....
T. P. to D. P. D. B.	.75	2.10	.....

FLEXIBLE CORD—Price per 1,000 ft. in coils of 250 ft.:

No. 18 cotton reinforced heavy		$15.00
No. 16 cotton reinforced heavy		19.00
No. 18 cotton reinforced light		12.00
No. 16 cotton reinforced light		14.00
No. 18 cotton Canvasite cord		13.00
No. 16 cotton Canvasite cord		15.00
No. 16 super service cord or similar (2 wire) in 1,000 ft.	$64.00	*71.00
No. 14 super service cord or similar (2 wire) in 1,000 ft.	92.00	*101.00

*Less than 1,000 ft.

NATIONAL ELECTRIC CODE FUSES, NON-REFILLABLE—

250-Volt	Std. Pkg.	List	600-Volt	Std. Pkg.	List Each
3-amp. to 30-amp.,	100	$0.15	3-amp. to 30-amp.,	100	$0.30
35-amp. to 60-amp.,	100	.30	35-amp. to 60-amp.,	100	.60
61-amp. to 100-amp.,	50	.90	65-amp. to 100-amp.,	50	1.50
101-amp. to 200-amp.,	25	2.00	110-amp. to 200-amp.,	25	2.50
201-amp. to 400-amp.,	25	3.60	225-amp. to 400-amp.,	25	5.50
401-amp. to 600-amp.,	10	5.50	450-amp. to 600-amp.,	10	8.00

Discount: Less than one-fifth standard package, 60%; one-fifth to standard package, 65%; standard package, 70%.

RENEWABLE FUSES—List price each:

Sizes	250-Volt List-Price	600-Volt List-Price	Std. Pkg. Quantity	Carton Quantity
1 to 30-amp.....	$0.50	$1.10	100	10
35 to 60-amp.....	1.00	1.25	100	10
65 to 100-amp.....	2.00	3.00	50	5
110 to 200-amp.....	4.00	5.00	25	5
225 to 400-amp.....	7.50	11.00	25	1
450 to 600-amp.....	11.00	16.00	10	1

REFILLS—

1 to 30-amp.....	$0.03 ea.	$0.05	100	100
35 to 60-amp.....	.05 ea.	.06	100	100
65 to 100-amp.....	.10 ea.	.10	50	50
110 to 200-amp.....	.15 ea.	.15	25	50
225 to 400-amp.....	.30 ea.	.30	25	25
450 to 600-amp.....	.60 ea.	.60	10	10

Discount Without Contract—Fuses:
Broken cartons..... Net list
Unbroken cartons..... 17%
Ten unbroken cartons..... 34%
Discount Without Contract—Renewals:
Broken cartons..... Net list
Unbroken cartons..... 17%
Ten unbroken cartons..... 34%
Discount With Contract—Fuses:
Broken cartons..... 5%
Unbroken cartons..... 20%
Ten unbroken cartons..... 36%
Discount With Contract—Renewals:
Broken cartons..... Net list
Ten unbroken cartons..... 36%

Carton quantities may be combined to obtain maximum discounts.

FUSE PLUGS, MICA CAP—

0–30 ampere, standard package (500), per 100	$2.50
0–30 ampere, less than standard package, per 100	2.75

LAMPS—Below are present quotations in less than standard package quantities on Mazda standard, A type bulbs:

100—130 Volt Watts	General Type	Price Each	200—260 Volt Watts	Special Type	Price Each
15	A 17	$0.20	25	A 19	$0.25
25	A 19	.20	50	A 21	.25
40	A 21	.20	100	A 23	.45
50	A 21	.20	...	.....	.....
60	A 21	.20	...	.....	.....
100	A 23	.35	...	.....	.....

Carton quantities are subject to discount of 10% from list. Annual contracts ranging from $75 to $300,000 net, allow a discount of 15 to 40% from list.

PLUGS, ATTACHMENT—

	Each
Porcelain, separable, attachment plug	$0.18
Composition, 2-piece, attachment plug	.27
Swivel attachment plug	.12
Small size, 2-piece plug, composition	.06

RUBBER-COVERED COPPER WIRE—Per 1000 ft. f.o.b. New York:

No.	Solid Single Braid	Solid Double Braid	Stranded, Double Braid	Solid Duplex
14	$4.90	$6.80	$7.60	$13.45
12	7.10	8.40	9.60	17.30
10	8.75	10.75	12.60	23.00
8	13.70	15.75	18.10	33.00
6	.....	.....	24.25	.....
4	.....	.....	36.00	.....
2	.....	.....	49.50	.....
1	.....	.....	55.00	.....
0	.....	.....	87.00	.....
00	.....	.....	101.00	.....
000	.....	.....	122.00	.....
0000	.....	.....	150.00	.....

SOCKETS, BRASS SHELL—Price each, net:

	½ In or Pendant Cap Key	Keyless	Pull	¾ In. Cap Key	Keyless	Pull
Standard package	$0.12	$0.10	$0.16	$0.16½	$0.14	$0.20
Unbroken carton	.14	.12	.18	.18	.16	.21
Broken carton	.16	.14	.20	.20	.18	.24

WIRING SUPPLIES—

Friction tape, ¾ in., in less than 100 lb., 28c. per lb.; in 100 lb. lots, 26c. per lb.
Rubber tape, ¾ in., in less than 100 lb., 30c. per lb.; in 100 lb. lots, 27c. per lb.
Wire solder, in less than 100 lb., 28c. per lb.; in 100 lb. lots, 26c. per lb.
Soldering paste, 2 oz. cans..... $1.10 doz.

ENCLOSED SWITCHES, KNIFE—Safety type, externally operated, 250 d.c. or a.c., N.E.C.:

TYPE "C" FUSED BOTTOM

Size, Amp.	Double Pole, Each	Three Pole, Each	Four Pole Each
30	$3.50	$5.70	$9.00
60	9.00	11.00	14.00
100	14.00	17.00	29.00
200	22.00	29.00	48.00

Discounts:
Standard package..... 50%
Less than standard package..... 45%